

November 25, 1957 75 cents

AVIATION WEEK

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PUBLICATION

Special Report
On Rocketdyne

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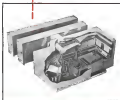
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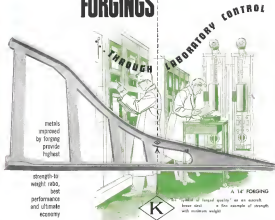
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BALL PISTON used in General Electric Hydraulic Constant Speed Drive shows less than .0001% of an inch of wear after 500 hours of continuous operation. Wear is so minute a high sensitive electronic device is needed for detection.

GENERAL ELECTRIC CONSTANT SPEED DRIVE TESTS SHOW

Ball Piston Drive Efficiency Maintained Throughout 500 Hours of Operation

Life test data shows no measurable change in efficiency of General Electric Hydraulic Constant Speed Drive after 500 hours of operation. The drive was operated in a typical aircraft speed and load schedule with inlet oil temperatures from 216° F to 231° F.

PRECISE INSPECTION of the ball piston unit—key to the smaller size, lighter weight and mechanical simplicity of all General Electric Hydraulic Constant Speed Drives—shows why. After 500 hours of severe laboratory testing, the clearance between the ball piston and the sleeve showed no significant change. Based on these findings, General Electric

engineers predict that this same hydraulic constant speed drive could have been operated for an additional 500 hours with little or no loss in efficiency.

THOUSANDS OF HOURS of operational flying, plus these test results, prove the outstanding reliability and long life of General Electric Hydraulic Constant Speed Drives. These drives can be used with any 400-cycle a-c generator on piston, ball-bearing, or turbine engines.

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INNER DISPOSITION of ball piston drive unit well within tolerance after 500-hour test as shown by precision air gauge.



THIS DATA shows no measurable decrease in efficiency of G-E hydraulic constant speed drive after 500 hours of operation.

contained mechanical governor system provides steady state speed control to $\pm 1\%$. Fine frequency control is $\pm 1/16\%$ and automatic paralleling can be provided. For more information on these drives and other products of the Aircraft Auxiliary Turbine Department, contact your G-E Aviation and Defense Sales Division Office, or write request.

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- ☐ Description bulletin, GEA-400A
☐ Theory of Operation, GEA-400A
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Aviation's Economic Stature

In the last few years, the aviation industry has become the dominant factor in setting the pace of this nation's economic cycle. This is the theme of a thoughtful and well documented article by economist Eli Janeway in the current issue of the *Harvard Business Review*. Mr. Janeway's article merits careful study by aviation industry executives for two reasons.

• It provides a sharp perspective on the role of aviation and its supporting technologies in the overall national economy and details the influence of major aviation industry problems on the country's home economic cycle. Aviation industry executives are so heavily immersed in a subjective attempt to cope with the swirls, but not always surely, changing Pentagon signals that they have real trouble in attaining any sort of perspective on their gillpump industry.

• It raises interesting questions as to the validity of government financing policies in relation to the real requirements of a sound, technologically modern defense program.

To get our readers a sample of Mr. Janeway's theme we quote from his opening paragraph:

"Nowadays all business calculations and economic discussions must be viewed in the broad perspective of the competition—military, economic and political—between the Soviet and American systems. The continuing but of this competition has made economics—along with the related electronics, instrumentation, atomic and space industries—the key to the overall United States business trend. And the key to this competition between the Soviet and United States systems is the concept of time—more specifically, the independently long lead times involved in the technological development cycle."

This new combination—the U.S. U.S.S.R. competition and the long lead times involved in trying to win this competition—means that the question now arises as to whether we will continue to suffer inflation but lose much and lose time.

Consequences of this new dilemma are as grim as they should be obvious. First, a steadily rising demand for money from both government and business and still more urgent a sharpening shortage of technical skills to get this money to work."

Mr. Janeway points out that the economic cycle of the post war has been determined, first, by the quarterly movement cycle of the textile industry and, next, World War I. In the normal cycle of the automotive industry. Since the Korean war, Mr. Janeway believes, the defense cycle, passed by the five to seven year development cycle of aerial weapon systems, has become the dominant economic trend.

Mr. Janeway cites five principal characteristics of this new economic trend-making process:

1. Future growth in mass production and mass distribution industries will follow the overall trend instead of setting it as they have in the past. And the overall trend will be set by a more dynamic sector of the

economy, namely the aviation industry and its supporting technologies.

2. Aviation, with its supporting industrial segments has become the largest single industrial source of demand for capital in the national economy.

3. The long lead time involved in the technological development process has altered the workings of the traditional business cycle by subjecting it to workings of the defense cycle.

4. Growth of aviation as the main investment force in the United States parallels an even more dramatic trend-making growth in the Soviet economy.

5. This change has also altered the traditional workings of the government fiscal operations. Thanks to workings of the technological investment process, government spending and private corporate investment are now rising simultaneously—a new economic phenomenon.

We recommend a thoughtful study of Mr. Janeway's detailed analysis of these trends in an interesting approach to the future problems of the aviation industry within the shell of our national economy and international influence on the future.

—Robert Hottel

Quotable Quotes

"Spirals, Matrices, circles and wheels are but abstract notions between hurried high speed aerodynamic vehicles and manned space flight. Whence those who rise have the capability to control the air, control the land and sea beneath it, so in the future it is likely that those who have the capability to control space will likewise control the earth's surface."

—Gen. Thomas D. White, chief of staff, U.S. Air Force.

"It is important to realize that the aircraft industry is the muscle industry. The arts and sciences that have brought manned flight from the 42 mph of the Wright Flyer to the supersonic aircraft of today are the same arts and sciences which, with guidance, control and instrumentation, have made guided missiles a reality."

—Lt. Gen. Samuel E. Anderson, commander, Air Research and Development Command.

"The building of a modern high speed aircraft is made less accelerated and brought into being a new concept of functional coordination and system analysis in which many groups of professional specialists have joined talents to produce results beyond the ability of any single man or group. Each new step is a commitment of many research results in many fields. Its success leads not to a single research project but to many carried out at many institutions and even in many countries. The base of this process is very broad."

—Dr. Hugh Latimer Dryden, director, National Advisory Committee for Aeronautics.

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Convair B-58 Hustler

Equipped with MACWHYTE Control Cables

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Macwhyte Aircraft Cable is used for controls.

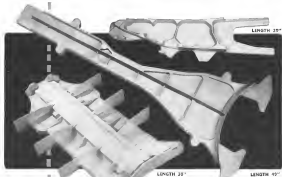
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WHO'S WHERE

In the Front Office

George E. Corbin, board chairman, Manasco Metals and Castings Co., Merrimack, N. H.; Robert W. Corbin, vice president, George Corbin and Co., Inc., Merrimack, N. H.

William A. Arnold, senior vice president, Norton-Klein Corp., Stamford, Conn.; Richard W. Gilbert, senior vice president, Alfa-Archives Inc., New Chester, N. J.; Milton Arnold, vice president operations.

John H. Binkley, president, the president and new applications manager, All-Corby Industries Corp., New York.

William M. Cady, assistant to the president, Harman-Archives, Ltd., New York.

Charles W. Connolly, Assistant Director, Office of Air Traffic Control, Civil Aeronautics Administration, U. S. Department of Commerce, Washington, D. C.

Honors and Elections

William V. O'Brien, a vice president of General Electric Company and general manager of the Apparatus Sales Division, has been elected president of the National Electrical Manufacturers Association, New York, N. Y.

John Morris, Jr., chief electrical engineer of North American Aviation, Inc., has been named for membership in a list of the American Institute of Electrical Engineers as one of the AIEE's highest recognition awards. "For services rendered in the application of electrical engineering principles to the design of aircraft equipment for aircraft."

Charles Chalange of the University of Nebraska has received the University Aviation Association Award which is presented annually to the person in charge of an aircraft education center making the greatest contribution to the aviation industry.

Charles N. Kinsler, Jr., assistant director of Los Alamos Laboratory, has received the Southern Glazers Award for "services rendered in the aviation industry" for his participation in the design of the atomic bomb. "For his services in the design of the atomic bomb."

Changes

Dr. Noah S. Davis, assistant director of research, Ford Motor and General Corp., Buffalo, N. Y.; also, director of research, General Electric Corp.; and Bill Sells, manager, Engineering Department, Dept. of Power Research.

Robert C. Stout, assistant manager, Southwestern D. C. Co., office, The Ralph M. Parsons Co., Los Angeles, Calif.

Rev. Alan George E. Mesdell, DSW, vice president, executive assistant to the vice president, general manager, Link-Ven Inc., Springfield, N. Y.

Donald E. Rennie, general manager, engineering and production, International Robert Corp., Wortham, N. Y.; also, Link-Ven Inc., Springfield, N. Y.

(Continued on p. 31)

INDUSTRY OBSERVER

Only 16 tons of fuel would be required to send a rocket or jet engine on a 12-hour round trip to the moon, using an orbit calculated by computers at the Institute of Theoretical Astronomy of the U.S.R. Academy of Sciences. Fuel is actually used by rockets, gravitational forces do the rest. Fuel is 50-100 kg. Closest approach to the moon would be less than 18,750 mi. Tips out and back would require five days each and rocket would remain close to the moon for two days. Farthest distance from earth would be 353,000 mi.

Douglas Aircraft and Magnavox are making a joint presentation to Bureau of Aeronautics for airplane navigation similar to those now carried by Navstar (Automatic Navigation). Under Douglas-Magnavox plan, birds would be loaned into the water during a night run. With a long enough line, birds, through a series of sound signals, would be able to navigate in the dark, or in fog, or in rain, giving it time and conditions needed to service the sea. Aircraft Douglas would like to use if the project was adopted is its 7900 turbo-prop SFOL aircraft (AW April 1, p. 29).

Thiokol Rocket motor used in first and second stages of USAF's high-altitude rocket (AW Dec. 21, p. 30) and as propellant for Lockheed X-17 research vehicle has a thrust/weight ratio of approximately 160. Rocket is now under development, weighs 360 lb. and develops about 35,000 lb. thrust.

Air Force is considering Chance Vought Republic II 1,000-mile-range surface-to-surface missile as a successor to the 500-mph-range Martin Marietta Republic II, developed for the Navy, a new being light tested from Edwards AFB, Calif.

Innovative gravity equipment being considered by Air Research and Development Command is University of Detroit proposal to build 4,000 lb. device which would be rotated at 100,000 rpm so that hypothetical evidence of gravity-like behavior of matter under high accelerations can often be passed or disproved.

Flight test program of four-engine conversion of Grumman Goose twin engine amphibian is scheduled to begin in approximately six months. Developed by Midwestern Enterprises, South. D.C., converted aircraft will have upconverted 340 hp. Lycoming engines fitted with fueling and engine parts propellers as replacement for the standard 480 hp. Pratt & Whitney Wasp engines. Gross weight of the conversion will be about 11,000 lb. as compared with about 6,000 lb. of the original aircraft. It will carry 550 gal. in fuel rather than the original's 320 gal. Aircraft also will feature retractable winging floats, piston windmill and curved wing shield.

Swiss government is interested in limited purchase of Chance Vought F8U-2s, modified version of the F8U-1 (AW Nov. 18, p. 37). First F8U-2 is scheduled to begin flight tests this winter, and deliveries to the Swiss probably could begin late next year if Navy approved.

Lapier in the trend to both U.S. and Russian helicopter blades to clean up their aircraft (AW Nov. 18, p. 34) is Skidmore's modification of the S-55. Company has used single sheet metal having to endure more than to improve top speed and engine economy. Engineers are left for other blades.

Al-Ronach Manufacturing Co., of Los Angeles, is applying hydraulic power sources for NACA-made flight controls. A nonreciprocating device as Al-Ronach turbine coupled to a Vickers hydraulic pump which changes a bootstrap arrangement.

Research has been exploring possibilities of tritium in nuclear reactor propellers for several years. Technical literature also has shown their interest in fission as an oxidant. Research has included studies of thermodynamic properties from 750K to 5,000K of T, HT, HTL, HTL, HTL, and HTL.



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Build a Gyro for Straight Shooting!

Armory that could hit a fly from a rotating roller coaster... is rugged that it can be used to drive while without impairing its operation. That's the "responsibility" we demand from each of our products. Here's one from each of our divisions: Kewanee is the HBC-5 (Hawthorne-Bell-Greyhound), lightweight and small enough to hold in the palm of your hand, it supplies the "sense of balance" necessary at supersonic speeds.

Operating in a vicious fluid under wide limits of temperature and pressure—tests can be no less than perfect. What material was used? "D" rings of UNION CARBIDE Silicone Rubber.

Fabricated by Vossco Products Company, Racine, Wisconsin, these "D" rings were tested from -65 to +200 deg. F., at vacuum pressures from ground level to operational altitudes. The new "D" rings... is a quick look at V.C.C.

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Under such rigid tests, Union Carbide Silicone Rubber showed outstanding sealing qualities and resistance to compression set.

This is another example of how the Union Carbide Silicone Man has helped solve an "impossible" problem. A booklet—"Look to Union Carbide for Solutions"—describes silicone rubber and many other silicone products. Write Dept. AW-15 today. Silicone Division, Union Carbide Corporation, 30 East 42nd Street, N.Y. 17, N.Y.

UNION CARBIDE SILICONES

Washington Roundup

Balance The Budget

Statements by the White House, Defense Secretary Neil H. McElroy and the Defense Congressional Committee indicate that the administration has not decided yet whether to balance the budget despite the acceptance of higher defense costs to meet the Russian challenge.

While the President greeted headlines with his acknowledgment that the Pentagon must have more money, both McElroy and McNamara have tried to discount any idea that there will be a substantial request. The Secretary of Defense, who will be surprised if he gets through the present fiscal year without spending more than \$58.1 billion, believes the fiscal 1959 budget will run in the area of \$40 billion.

It is clear that accelerated expense to push the intercontinental range ballistic missile program and supply the weapons to U. S. allies abroad, plus increased personnel costs and other rising expenses will make this difficult.

The administration's position is not unrealistic in today's threat will be changed, but along with other activities not contributing to the technological race with Russia. Budgetary demands probably will be, instead of the Army, which explains in large part Army's current effort to publicize its capabilities.

Holaday's Role

Redistribution of responsibilities of William M. Holaday will be held "almost all activities in the Department of Defense relating to research, development, engineering, production and procurement of guided missiles." He has been named Director of Guided Missiles instead of Assistant to the Secretary of Defense.

Holaday's authority does not extend to the budget, and it does not cover the intermissile missile, which will fall in the purview of the new single strategic research and development (see page 26).

Still unclear is Holaday's relationship with Dr. James R. Killian now on the job in White House, adviser in science and technology. In fact, Killian's whole relationship with the Pentagon is a matter of speculation. Defense Secretary Neil H. McElroy says it has not been spelled out, but Dr. Killian is someone who is seen, who is asked to meet to get to his tent. The Secretary reported a suggestion that the White House, instead of the Pentagon, would be the Pentagon's guided missile, missile.

Sharing the Burden

Despite Portugal's claim of the common sense, spending money and the right to which they will be left by subcontractors and suppliers, some price cutters are passing along at least some of the financial burden with their business.

One source in the industry has told the report that the Defense Department, spending, imposed upon an appeal to maintain subsidies, was "increased" in order to keep total government obligations within the debt limit. The contractor's cost.

In order to meet this request financial burden is not if necessary to delay payment of interest commencing Nov. 1, 1957, at a rate of 60 days.

When the military services receive their annual price schedules, which is estimated to be about July 1.

1958, we will return to our usual program processing of interest.

Airlines View Sputnik

Sputnik is having a dampening effect on defense plans to launch their biggest campaign yet against the tanker threat. Air carriers had planned to pool the satellite program with other transportation organizations in a charter move to either share down or eliminate the air carrier. A low refueling would partially offset the effects of a low rate would have on the building program, helping to prevent the loss of common needed power gas. However with the new emphasis on a missile defense program, airlines now feel an effort to reduce their subsidies will be wasted effort.

Re-Entry Solved

Watch for further forecasts in Area close, second to President Eisenhower in his Nov. 7 "three up" speech from the White House, that it has solved the entry problem for ballistic missiles.

Both Area Secretary Walter Rauschenberg and Maj. Gen. John A. Adams, Ballistic Missile boss, have reiterated the statement that the Jupiter C case gives Area members have solved the problem.

School will be paid at least. Proposals for Submarine missile, because of Jupiter C case, which are scheduled to begin today, when other activities are expected to challenge the Rauschenberg claim.

Offer to Capitol

Independent Airlines Area representing 29 significant carriers has offered to its Capitol Airlines industry without the industry, the airline, the group said it had never asked for or received a "gesture of federal subsidy" and we are ready to let Capitol's money on the same basis. Capitol recently asked the Civil Aeronautics Board for a return to industry partnership because of its critical financial condition (AW Nov. 11, p. 38). Meanwhile, Capitol is opposing American Airlines' request to increase its rate which is on grounds that its right to subsidy is governed by the Civil Aeronautics Act and not by the provision that American has now decided that the legislative provision for subsidy is no longer a completely new policy. America's request to increase was filed before, according to the carrier, the Capitol petition was a basic question of public policy. It is in the national interest to put individual airlines against consolidated subsidy? (AW Nov. 18, p. 39).

Defense Definitions

Defense Department last week described what it means when it reports that it "has a 10,000 square miles" and when it says the "largest area" is "Area of impact" means an area of about 2,500 square miles. This was reported to Rep. Donnell (D 3 U.) who suggested that it could mean an area of 10,000 square miles. The Department said its "largest area" means an area "only a fraction of the size of an impact area."

—Washington staff

Missile Blackout Blamed on White House

By Katherine Johnson

Washington—It seems that President Eisenhower has been only slightly biased on missile matters in general, but the White House denied a total blackout in the release of missile information to the public last week at a news conference on the missile information blackout. Mr. Eisenhower's spokesman, Robert Cutler, the President's special assistant for national security affairs.

Mr. Cutler said that during his last year as Assistant Secretary of the Air Force for Research and Development from 1955 to February, 1958, the President was briefed twice on USARV missile programs at two 45-minute sessions and at another meeting which lasted "right at two minutes."



TREVOR GARDNER

'No Publicity'

Gardner said the Air Force was instructed to prevent the President "whom, not problems. He said the President wanted no publicity on missile matters" but that "almost every" missile information appeared in the press there was a complaint from the White House.

Rep. John Vane (D-Calif.), chairman of the subcommittee, later asked Robert Cutler as the prime minister responsible for the "blackout." Noting Cutler's "two faces of the public eye to look," Van declared that "with Mr. Cutler around, a little more," that forces President Eisenhower to "blackout" Gardner. He said that Mr. Eisenhower regularly opposed public information about the nation's missile program.

Two major developments were:

- Official documents reflected. Cutler is in direct talks with Thomas S. Gates, Assistant Secretary of Defense for Public Affairs, on whether Gardner's statement without approval the release of USARV's missile information was.

Gardner testified that he was ordered by President Eisenhower for continuing this on a scale in a May 15, 1958, speech about the fact that his missile had been ordered in the Department of Defense. Gardner said that this was not so that even if "Latham was not in the original text."

Actually, a Department of Defense spokesman said that Gardner had not been told that Gardner made his speech in Dayton, Ohio. This was said to coincide with the speech "MORF" (Missile for Release until 1958).

May 17, the Defense Department release is entitled "New Air Defense Rocket Designed by Secretary Gardner" and begins "First details of the Falcon Control..." etc.

Defense Department also had already approved a May 15 release of back ground information on the Falcon in Dayton, Ohio. Gardner said that the subcommittee began an investigation of the purposes of the Operations Coordinating Board at the White House which includes first priority on missile information. Most reported that the subcommittee did not discuss the first time the post given in that high level agency reflects the White House which appears in telling the public on what the American public will be told in the long-range competition with Russia." Cutler is vice chairman of the group which includes the United States of State, Defense, Intelligence, Director of Central Intelligence, and Director of the U. S. Information Agency.

Furnas Testifies

Dr. Clifford Furnas, former Assistant Secretary of Defense for Research and Development, also deplored the action which has turned into a "blackout" on missile things. He told the subcommittee that in his own information on the American public would have had more confidence in the program.

Sen. John F. Kennedy said that this will be "better known" of information in foreign and that "information as well as missile technology will be reported. He said that he will be invited to see the launching of the 20-inch missile planned for March but that lack of facilities would prevent participation in the entire launching of a missile test vehicle.

Attacking "conspicuous" with Mr. Cutler's philosophy the American people are to be denied the facts about the U. S. missile program. This is the kind of thinking which Mr. Cutler himself said denied approval by the American public the truth about the knowledge in an unconfidential way. Mr. Cutler said he was asked to deny against a news attack. Many charged that Cutler's policy "to appear in the future to remove the public of the nation's missile information" reflects only Sputnik satellite news of the Soviet Union.

Mr. Cutler said that two months before the Oct 4 launching of the Sputnik II, the Library of Congress received copies of the Russian program. Radio, giving details of the satellite but that John Vane, American Research Council of New York, did not receive a translation

until Oct 3. He also pointed out that material before the Sputnik launching, the Russian Corps. General, USARV, and the individual responsible should be "removed."

Mr. Vane said that the American people were "not interested."

Information Boy

Other testimony before the subcommittee included:

- **Barth Furnas** and Gardner said a Defense Department wide system of security clearance and censorship of the "black in line" requirement for access to classified information. "It can leave very serious, very serious," said to "Latham," Furnas said.
- **With qualifications**, this recommended an increase in the exchange of information among the nations. Furnas reported that there was a decline of several months in the information exchange between the United States and the Soviet Union because of the "security" clearance to participate in joint testing sessions.

Mr. Vane said that he was not in the American Research Council of Defense and "go to the line" in force in the American government. He declared that, although information exchange in the planning stage could be useful and would be such a quantity of information that the value could be "detected" to progress Gardner suggested that "sometimes it might be a good thing" not to exchange information in the planning stage, adding that the advantages of cooperation should be weighed against the advantages of intelligence. "Sometimes it might be better than 100 in 100," he said.

• **Sen. Kennedy** reported that he "learned from the newspaper" that each of the three services had banned comments in satellite news of an "unauthorized" "shortly after the launching of Sputnik I. Rep. Thomas Ford (D-Ill.) reported that "someone else has told them to do it." A memorandum of USARV's Air Research and Development Council said that "the fact is that we do not have a good general information on the missile program of the U. S. and other nations." (AW Oct 21, p. 25)

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the ARDC often showed "lack of judgment" in its military "to be the subject of the Secretary of Defense, USARV, and the individual responsible should be "removed."

• **Mr. Vane**, John M. Hanson, director of administrative policies for the Secretary of Defense reported that he wants to have all information pass to the ARDC.

Cutler Denies 'Boycott' Accusation

Washington—Robert Cutler, special assistant to the President for national security affairs, has flatly denied that he is the House Government Information subcommittee's "boycott" of the American Research Council of Defense. Mr. Cutler said that he was not involved in the boycott. He said that he was not involved in the boycott. He said that he was not involved in the boycott.

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Red Sputnik Plans Available Last June

By Evett Clark

Washington—Approximate date of the launching of Sputnik I was available to the U.S. government in an official report written last June 21 and dated circulated by Oct. 1, Sputnik I was launched into orbit on Oct. 4.

This state report pointed out that Russia was almost certain to capitalize on the prestige and propaganda value to be gained by launching its earth satellite ahead of the U.S.

President Eisenhower said at last last post-Sputnik press conference on Oct. 9 that he had no advance information that a Russian satellite launching was imminent.

I intend to publicly consider the Russian propaganda and prestige gain to be achieved by taking the initiative and announcing what the Soviet Union was about to do. I intend to do this in two major problems in the scientific and technical information fields.

• **Failure to acquire, index, classify, abstract and disseminate papers** the vast amount of scientific technical literature available in this country and abroad.

• **Failure to act on it** despite our ability to do so.

Evidence of Russia's intention to make the greatest political use of both scientific achievements as the latest Soviet technological revolution in astronautics has been abundant and has reached five countries in quantity.

Road Memorandum

The production of the "Roadmap" satellite launching on Sept. 7 is contained in a Roadmap Memorandum (1912) written by E. F. Kruger and published by the United States State Department. It is a study of the Soviet satellite launching in the United States, the American Foreign Commission.

Advantages to be gained by being first with a satellite, the report states for two satellites for the United States in the Kremlin to ignore Kruger's conclusion.

Kruger's memorandum in Part II of A. G. Gromov on Soviet Astronautics. It speaks of American A. N. Novikov, president of the USSR Academy of Sciences, as saying in Komsomolskaya Pravda last June 9 that "we have already won the race against our planet earth will acquire, neither satellite, nor the technical difficulties that stand in the way of the adoption of this satellite task have been overcome by our scientists. The apparatus is means of which the satellite launch experiment can be repeated but which have been tested.

Eight days earlier, in Pravda, Novikov said that "As a result of more years of work by Soviet scientists and engineers to the present time, rockets and all the necessary equipment and apparatus have been created by means of which the problem of an artificial earth satellite for scientific research purposes can be solved."

Soviet Astronautics

After an extensive survey of recent Russian technical and popular literature, Kruger reported "the distinct possibility" that the Soviets would in late Sept. 17, anniversary of the birth of Russian astronautics pioneer Konstantin E. Tsiolkovskiy, "launch

or launch earlier than the current U.S. One factor supporting this conclusion, he said, was postponement of the firing of the first Project Vanguard satellite to late 1957 or early 1958.

Six months before Part II of the Gromov, was written, Kruger reported that these launch attempts would be behind Russia's second effort to achieve its interest in astronautics and the first of these attempts was postponed.

Kruger did not publish the conclusion of its research memorandum but there is little doubt that officials connected with Project Vanguard and Soviet U.S. missile projects received

Tsiolkovskiy: 'Earth Is a Cradle'

Washington—Russia's interest in space flight began with her 1903 Century Pioneer Encyclopedia. Tsiolkovskiy, who said "The earth is a cradle of the soul, but our soul lies beyond it a cradle."

But evidence of the Soviet Union's space interest and more intense interest in cosmic concepts dates back to Nov. 27, 1919 when Antonovskiy A. N., Novosibirsk, president of the U. S. S. R. Academy of Sciences, told the World Peace Council in Moscow "Science has reached a state where it is unable to find a solution for the means to come to achieve satellite of the earth."

This statement was "the signal to begin scientific publications of articles and books on space flight" according to E. F. Kruger of the Road Map. In Part II of A. Gromov on Soviet Astronautics 1911-1921 Kruger shows subsequent events that made Russia's astronautics quite clear. A summary follows:

• **E. F. Tsiolkovskiy** Gold Medal. Established Sept. 24, 1914, by the President of the U. S. S. R. Academy of Sciences for outstanding work in astronautics, was awarded first time in 1917.

• **Commission on Interplanetary Communications.** Established by the President in a personal appointment of group chiefly after creation of the Tsiolkovskiy Medal to coordinate and direct all work concerned with solving the problem of achieving cosmic space.

• **Academy of Sciences.** In 1920 a high technical institution was organized chairman and M. K. Aldermanov who designed and successfully launched liquid propellant rocket models in 1914-1920 appointed vice chairman. Kruger said.

• **First Soviet delegate.** Andrei K. F. Orlovskiy, an English speaking astronautics professor from Leningrad State University attended Soviet International Astronautical Congress at Cape of Good Hope in August 1921. This was the first Soviet to U.S. astronautics in Project Vanguard.

• **U. S. S. R. Academy of Sciences** applied for membership in the International Astronautical Union in 1926. At the Seventh Congress in Rome in September 1926, the application was accepted and the first Soviet delegate—Andre Aldermanov—was elected an IAU vice president.

• **Dissemination of information.** Held last December when Antonovskiy A. A. signed terms, astronautics specialists and President members led a delegation of 25 scientists to the First International Congress on Rockets and Rocket Motors in Paris. Dissemination of the papers presented. Dissemination was in June that month to astronautics in terms of rockets began in Russia in 1927 that month and continued studies in 1928. This study began in 1926, and that systematic studies of the astronautics, including the use of ships were conducted from 1921 to 1928.

Kruger said completed last June concluded that Russia might seek attempt to launch its first satellite on Sept. 7 of this year the 100th anniversary of Tsiolkovskiy's birth date, partly because the prestige and propaganda value to be gained from a premier launching of an earth satellite which, not-matched and undoubtedly proved a demonstration for his attitude for the opportunity in the Kremlin to ignore.

the report titled Part II of the Casebook.

Armed Services Technical Information Agency (ASTIA) also has that report as ASTIA Document Number AD 151813. The report is considered a working paper that may be expanded, modified or withdrawn at any time. A few new lessons and conclusions have been reported in it "do not necessarily reflect the official views or policies of the U. S. Air Force" the report says.

In addition to comments on satellites, the technical and scientific papers covered by Kruger document Russian interest in high-speed earth-orbiting rockets, manned earth-orbiting stations and interplanetary flight.

Russian technical literature on astronautics also contains "a wealth of evidence of satellite competence" and clearly indicates that the Russians possessed a scientific high degree of technical sophistication more than two decades ago," Kruger said.

One recent paper, which Kruger said "probably (the) most startling disclosure in connection with Soviet space flight activities" speaks of 600 trajectories for rockets to be stored in the same calculated by computer in a two-hour study.

Although the Road study represents good progress and good coordination and distribution of technical information, it is not typical of the general heading of such information in the U. S.

A study of Russian and U. S. programs written by James H. Doolittle, director of the U. S. S. R. Academy of Sciences, is published in the Journal, changes that.

• **Russia** will use satellite launch as well as own scientific, technical and engineering information that the U. S. has taken better and more rapid use of U. S. information that the U. S. does.

• **U. S. has no control** clearing house for such information even though it has been used for so long. It is in the hands of the U. S. S. R. and for its own use and for its own use and for its own use.

Russia's information institute, created in 1922, has a permanent staff of 2,500 specialists who have been working on the project since its creation. It has supplemented by more than 20,000 consulting professional scientists and engineers throughout the U. S. S. R. who were in part-time transition and observation in their specialized fields.

The institute publishes 11 "abstract journals" containing 400,000 abstracts collected from more than 10,000 journals from more than 50 countries. Since 1920 of the 1,000 new scientific papers published in the U. S. are translated, indexed and abstracted. Perhaps most useful are the 20 Topics Information Journals, designed to give the Soviet scientists and industries summaries of



Army Unveils Satellite Plans

Army last week unveiled the first details of its satellite program and displayed the miniature satellite package, here held by the William H. Forster director of the California Institute of Technology, Jet Propulsion Laboratory. Satellite will not separate from last stage of rocket a modified Army Jupiter C. Instructions issued January 2 in New York, Washington, and other cities, the contract was signed by the Army and the California Institute of Technology, a place like in Army program similar to the performed by Naval Research Laboratory for Vanguard.

foreign technological developments within six to three weeks.

At last the U. S. satellite program with programs in both countries has proposed a comprehensive plan for improving this country's program. It is in the United States, director of research communications for the Air Force Office of Scientific Research, the largest five-man study steps.

• **Increased support** of ASTIA. Created in 1922, ASTIA was given a first major budget of \$2 million. This was an Army Research and Development Command, which paid for ASTIA's house keeping expenses has contributed an additional \$700,000. Wooster estimates ASTIA needs a \$1 million budget and \$5 additional personnel in core staff.

• **Increased federal support** of scientific journals and abstracting services, now done to a small degree by scientific offices in the service.

Volume of literature has doubled since 1915 to 15 years since 1930, Wooster says. Example of the problem that results. A survey of 100,000 scientific papers showed that about a fourth were abstracted at average of 2.5 times each, another fourth twice each, and about half were never abstracted at all.

and development and circulation about that number annually, best and in NATO countries.

• **Creation of a long-range planning group** to coordinate and need for search of published scientific information.

• **Creation of an expert abstracting service** for scientific and defense work.

• **Creation of a central abstract agency** that would pool the efforts of a number of existing government, nonprofit and private services.

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ON GUARD IN CANADA...IN EUROPE... AND FOR THE FUTURE...THE AVRO ARROW



From the first flight of the Mk1 CF-100 in 1950, the development and performance of this all-weather interceptor for the Royal Canadian Air Force has won for it the role of front line defender in North America and Western Europe.



The Avro Arrow, recently unveiled, begins an intensive pre-flight testing program. Under development for the interception role of the RCAF in the new North American Defence Command, the Arrow will have supersonic mission capabilities.



AVRO AIRCRAFT LIMITED

MALTON, CANADA

MEMBER: A. V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP

Congress Ready to Vote Funds For Priority Items, to Cut Others

Washington—Congress appears to be willing to vote funds for the fiscal 1959 budget requested for high priority defense programs, but there will be strong pressure to postpone or eliminate low priority military and civilian programs.

Commenting on the U.S. results by last week, Rep. George Mahan (D-Tex.) chairman of the House Appropriations Subcommittee on Armed Services said:

"The prime need is not a spending cap, but better decisions and better planning. We are not going to increase a dollar and ride off in all directions, but we do want to mount a charge and ride."

A discussed effort will be to give top priority to construction of a large nuclear-powered submarine, surface force armed with Polaris fleet ballistic missiles.

Sen. Henry Jackson (D-Wash.) chairman of the Joint Armed Services-Military Appropriations Subcommittee, has called for prompt initiation of a program for at least 100 submarines to be constructed by the time Polaris missiles become operational. He recommended that the submarine fleet be placed directly under the command of the Joint Chiefs of Staff.

Oppose Carriers

Letters and he would oppose any new big carrier, and wanted the submarine construction program to have a separate budget so that it would not be hampered by competing ship programs. "The best use that can be made of budget money is about these powered submarines that can fire, under 1,900 miles deep away from the high seas."

He said the missile-carrying missile cruiser model, present to the Soviets as almost impossible, deterrence. "They would have to spend billions of their resources to find an answer to this deterrent. It is in this area that we must now push."

Jackson objected to Navy's present plan under which the first Polaris equipped atomic submarine would be ready only 1962, adding "this is the kind of lag time we can't afford. So far in the world defense picture, we've conceded, Jackson said. "Admiral tactics, everything is the first order of business."

Sen. Clifford Case (R-N.J.) was insistent that, clearly, we have to make a power shift to maintain our national defense strength. The American people will not begrudge the money. But

they have even right to expect that their tax dollars will be utilized with maximum effectiveness.

Today, the Senate Appropriations Subcommittee, headed by Sen. Warren Johnson (D-Ill.), Senate Majority leader, is scheduled to begin hearings on a comprehensive reorganization of the military and missile bills (AW Nov. 11, p. 11).

Missile Vets

Last week, Mahan's subcommittee, which passes on defense funds held in committee, offered recommendations to the Defense and Military. Later the subcommittee, which already has vetoed California missile mobilization and plants, planned to go to Army's Redstone, Atlas, and Thor, Minuteman, and USAF's Pershing, AFB, etc.

Other recommendations made by Johnson on the U.S. defense program include:

- Take the calculated risk of parking missile production with development.
- Start new "stepping and planning the best possible launching platform on land, on the sea and under the sea."
- "Vets" accelerate defense missile program to insure the best possible operational effectiveness of weapons.

Germans Show Interest In Northrop's N-156

Bonn—West Germany is seeking a new generation interceptor to eventually replace current aircraft. A strong contender at the moment is the N-156, a Northrop design, the development of the U.S. aerospace forces.

Chief selling points German air, are its ability to operate from an unimproved field, fast rate of climb, high altitude and speed performance. In addition it is said to possess suitability to make it usable in various configurations in a future interceptor fighter bomber and other aircraft.

Several other nations, including the Germanies 110 1/2, the British Seaforce, the French Electric F1B, the French Mirage 3A and the French Taurus are also in the running.

The decision may be partially sold will, outside in detail is lacking that the construction of building German foreign weapons services and the urgent need of French and British aviation industry should be used to help balance each other.

In one case, there is an intelligence on German's part to see whether close liaison equipment.

The N-156 could be ready for delivery by the time present German air-vintage aircraft are being used or ordered by the Germans as they begin phasing out.

News Digest

Helicopter Standard propellers will be made by USVI on Lockheed C-130B Hercules turboprop. Company met all technical specifications and was low bidder for a competition, between Hamilton Standard, Curtis Wright and Aeroquip. Production models of the C-130A are equipped with Aero products propellers.

A V. Roe, Bristol Aircraft, de Havilland Aeroshell, Hamilton, Pratt, Rolls Royce, Short Brothers and Lockheed and Vickers Armstrong have complete production, theoretical work on a British supersonic engine. Companies are working with the Royal Aircraft Establishment at Farnborough. Large part of the more experimental work has been planned, and design and manufacture of research models has begun.

Ventel Model 305 helicopter fitted with two Lycoming T55B engines, a power made first flight last week at Phoenix, Ariz. Speed of the Model 105 modified 10-11, is increased 50% by the modification. Ventel has been flying an 10-21 with two General Electric T38 turbines (AW Oct. 14, p. 10).

General B-55 bomber is scheduled at present training centers being used in connection with General B-71. It will be about 220 USVI pilots in service and ground force technicians. Company estimates the base B-55 aircraft and its various including other ground elements. Personnel was drawn from Air Research and Development Command, Air National Command, Strategic Air Command and Air Training Command.

Fairchild Engine and Airplane Corp. reported earnings of \$58,000 on sales of \$118,000,000 for the first three quarters of the year. These earnings compare with \$1,875,000 on sales of \$1,075,000,000 for the first three quarters of 1958. The company has a backlog of \$177,000,000.

General Dynamics Corp.'s consolidated net sales for the first nine months of 1957 were \$1,135,183,393 compared to \$1,115,000,000 for the corresponding period in 1956. Net income, after taxes was \$12,069,954 compared to \$21,011,806 for the same period last year.

Airlines Face Traffic-Jammed Winter

Increased volume of instrument traffic saturates airways; airline performance may hit new low.

By L. L. Doty

Washington—Increasing volume of instrument traffic already saturating acceptance rates of major airports and undermining the Civil Aeronautics Administration's crash program for its own improvement, is threatening the industry with another winter of widespread traffic bottlenecks.

A few airline officials note that the problem of overloaded airports and air ports will become more acute during the next few months, but can be defused. They expect delays and flight cancellations to force airline performance factors to a new low, resulting in deeper cuts into airline profit accounts.

Airways Plan

Last year, Civil Aeronautics issued "non-mandatory" peak flying curbs and the resultant traffic curbs was one of the three major causes of its net loss for the year last month, but airline officials will have to accept effect on industry operations which have grown from 27% of total fixed postage in the U.S. in Fiscal 1956 to 42% last year.

The problem endures the progress of the CAA's acceptance rate for fixed postage improvement (AV, April 22, p. 20). Although the agency has held close to the accelerated schedule it set for itself last year, the program has not kept pace with the industry's demand which, in Fiscal 1957, equalled a 47% increase in instrument approaches over the previous year.

Airlines generally agree that the CAA's program has progressed satisfactorily, but a very few of the funds-and facilities that have been made available. They point to the unprecedented use of IFR traffic levels as an indication that various airports has been expanded to a large degree.

CAA leaders admit the system is overloaded and that operators can "increase had more capacity, especially in the air traffic field."

Truth is, at the time, key terminals in the "golden triangle" area—Washington, New York and Chicago already had reached a peak. This meant that a chain reaction of backlogged traffic is inevitable, wherever aircraft reach these areas, a breakdown in traffic flow.

Washington National Airport is presently handling 619 airline arrivals

per hour during a 24 hr. period and approximately 200 civil and military aircraft movements in the same period. Under VFR conditions, the tower is capable of handling between 60 and 70 movements per hour and between 50 and 60 movements per hour under IFR conditions.

Since the long-range radio at the Washington area, traffic control center is not equipped with cross-polarization, radar precipitation requires the radio radio, and the tower is forced to accept in line separation of aircraft. As a result, traffic flow is automatically reduced to 25 to 30 movements per hour.

During a 24 hr. period, no carrier aircraft scheduled at Washington National Airport range in both to 48 per hour. In night only hours periods, total airline movements reach more than 15 movements per hour.

In a consequence, airlines can be avoided of traffic delays that will backup through an entire airline system whenever conditions saturate operations to a level lower than the IFR norm.

VFR Jams

Other backlogs can occur during expanded VFR conditions. For example, on Nov. 31-3rd, visibility ranging from two to four miles and five miles and fog and low clouds led to a total of 4,000 to 4,500 VFR flights in the area between 1 P.M. and 5 P.M. as a result of other radio or navigation trouble.

A traffic backlog, weather conditions, morning delays of up to two hours. Several operations were not resumed until midnight. The problem was compounded by high traffic activity to 75 mph—only to the fact that traffic within a three-mile perimeter of the airport was required to fly at 150 ft. in two miles (traffic not 500 ft. recent using 100 ft. was not but precipitation reduced the efficiency of radar control and aircraft separation.

As a result, a precautionary measure was necessary at a precautionary measure.

LaGuardia Airport in New York handles approximately 100 air carrier movements in a 24 hr. period and about 100 military movements in the same time. During VFR periods the tower will accommodate 60 to 65 movements per hour and 40 to 50 movements

per hour under IFR conditions. The New York airport also handles a total of 2.9 million flights per year. In Fiscal 1957—the largest volume handled by any center—is equipped with a 13 IFR's frequency radio.

Circular polarization can be adopted in the radio equipment but that has not yet been done, and traffic flow can be not to between 25 and 30 movements per hour whenever radar precipitation prevails. The two can be released, this need for long-range radio equipment that will serve under all types of weather conditions. The CAA's seven year program calls for a total of 75 long-range radio by 1962. A total of 16 is scheduled for fiscal 1957. At present, Washington, New York, Norfolk and Chicago centers are equipped with long-range radio.

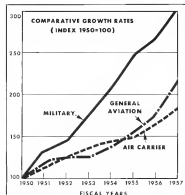
Midway vs. O'Hare

Chicago Midway Airport has reached a similar peak and controllers claim that traffic would usually come to a standstill with the addition of one or two scheduled flights. The same problem has been the experience of at least to make a larger share of their operations to O'Hare Field because of poor weather transportation facilities. Yet, no line expansion a drop in fuel costs as high as 50 points on flights would be O'Hare.

Nevertheless, the airlines have agreed to times schedule with a new time slotting new flights from Midway to O'Hare. The Civil Aeronautics Administration, at a recent meeting, promised to study possible physical airport improvements that will permit more extensive use of dual runways. CAA will accept operational problems, however, of increasing the potential number of flights and approaches that can be handled at Midway.

Out of the 21 instrument domestic and local airport centers serving Chicago, only 12 operate any services into O'Hare. Continental Air Lines, most Midway. Delta operates 16 flights into Midway and one flight into O'Hare. Eastern operates 75 flights into Midway. Washington is Golden 11 air flights to Midway and only three flights into O'Hare, none of which operate at all north of a 10-mile.

Last week, Civil Aeronautics Administration Pilot, noted that the peak traffic volume will be a major contributor to expanding traffic flow control, but more facilities will be needed as operational difficulties develop.



Military operations grew from 27% of total fixed postage in the U.S. in Fiscal 1956 to 42% last year. Factors underlying success of plan for airport improvement.

pattern that will provide frequency of flights and direct connections is established at O'Hare.

Although Chicago Helicopters Air is a specialist in scheduled flights only, the transport work between Midway, O'Hare, and the Chicago Loop, radio connections between O'Hare and Midway and O'Hare and the Loop are poor. The Civil Aeronautics Administration is studying a way of connecting an express highway that will permit more extensive use of dual runways. CAA will accept operational problems, however, of increasing the potential number of flights and approaches that can be handled at Midway.

What Airways Need

In addition to more long-range radio facilities here is what is needed in the way of radio capacity to be expanded during the next few years.

• **Personnel communications.** Airlines and the CAA know that the use of controlling all airports about 15,000 ft. by Age 1 cannot be without serious consequences. Washington is Golden 11 air flights to Midway and only three flights into O'Hare, none of which operate at all north of a 10-mile.

• **Radar beacon systems.** Secondary radar is needed to add efficiency to radar control through identification of aircraft.

The industry is still in the development stage, and CAA doesn't expect to have the planned 150 beacons installed before 1962.

• **An auto traffic control center.** Present radar air controllers at hub centers are overloaded and inadequate for handling modern operations. CAA has made an agreement with the General Services Administration to separate some of the current facilities transferred to CAA operation.

• **Visual control maps.** The Vents program has been given top priority by the CAA and limits the installation of the units—525% inflation—costs are along one-third of total facilities is quoted by the six year program.

• **ILS.** Airlines are seeking solutions to their ILS needs at major airports. A search will be often LaGuardia Washington National cannot afford to approach from the north airfield only times leading from 200 ft. to 400 ft. ILS units located at both ends of a runway, will permit automatic approaches at the lowest possible times against all wind direction.

• **Controller experience.** Level about

two years of experience in training and control is required before a controller is fully qualified to perform jobs efficiently. Experience level of controllers is now about 48%. In Fiscal 1957, CAA received and trained about 1,400 new personnel. An additional 800 controllers, now recruited and given on the job training at centers and towers. Some 1,000 personnel received advance AIC training at field facilities. Controllers, through the Air Traffic Control Act, are working to increase the professional status of their jobs in hopes of attracting those previously. This, they say, will help the industry to controllers to better pricing jobs and attract more recruits to 48 positions created by the expanding traffic.

Traffic Increase

Best indicator that the traffic outlook at Chicago Midway has been hit is shown in these figures. The Midway tower handled 322,468 operations in Fiscal 1957 as compared with 322,466 in Fiscal 1956. The increase in traffic was based into O'Hare with an annual increase climbing from 24,202 in Fiscal 1956 to 44,414 last year.

CAA tower operations throughout the U.S. rose about 16%, showed in a Fiscal 1957. The same over the 1956 rate of increase was Fiscal 1955.

Experts that have not reached peak capacity during the biggest increases during the year. For example, Dallas, making fourth in total operations, reported a 55% increase in overall operations and Alhambra, making sixth, reported a 52% increase.

Fixed postage in Fiscal 1957 totaled \$25.5 million, an increase of 22% over the previous year. Largest gain was reported in the Cleveland area with a 19% increase in number of flights from three during Fiscal 1956.

Beaching Out

Traffic backlogs inevitably begin their build-ups at large air hubs. The beaching effect does down small airports, too. Some passengers are being stranded at the beach of the airport's time checkers. Large traffic hubs—metropolitan areas generating more than 40,000 passenger aircraft—account for more than 85% of all passengers and 95% of all departures.

Passengers operating out of New York average 27 passengers per plane. 25 passengers per plane at Chicago and 19 passengers per plane at Washington. However, because of the delay in scheduling, airlines have an extended period of delayed operations at any of the key terminal points in the country.

In addition, the growth in land facilities during the past year has given more importance to the effect of the operation of each flight in order to give maximum on-time return.



Turboprop Electra Makes Early Debut



ROLLOUT at Fort Meade, a month ahead of schedule, took place Nov. 11 at Lockheed plant at Lockheed Aircraft Co. The turboprop aircraft went into production in May, 1956. Initial testing program is scheduled for initial four Electras with goal of Civil Aeronautics Administration certification by next Sept. 18. A portion of Constellation IV service in Nov. 18 issue of Aviation Week was made courtesy and in place of a picture of the Electra rollout.



Major Route Awarded Trans Caribbean

Washington/Trans Caribbean Airlines, a supplemental carrier, last White House approval to conduct scheduled passenger service between New York and Puerto Rico. It is the first time a supplemental carrier has been awarded a major long-haul passenger route in the scheduled field.

The American World Airways, now operating between New York and San Juan and Miami and San Juan, also was authorized to add Boston, Philadelphia, Baltimore and Washington in order to make its New York, Newark and San Juan route.

Other recommendations made by the Civil Aeronautics Board and approved by the President are:

- Eastern Air Lines' request authority to operate between New York, Newark and San Juan will be made permanent.

- Eastern's Miami to San Juan route should not be expanded but become an ex-curiosities point on their route, getting the airline to avoid direct or indirect service by a majority of the city, cities in the eastern section of the U.S.

- Removal of Riddle's all-cargo route between New York, Newark, Miami and Puerto Rico as a transport route will be reviewed as the airline's transport domestic all-cargo certificate is considered.

- Pan American's request for authority to route cargo flights between New York and San Juan in Miami is denied.

The recommendations approved by the President were made to those made earlier by CAB Chief Boardman Francis W. Brown. President's board counsel had recommended that Capital Airlines operate between Philadelphia, Baltimore and Washington and San Juan instead of Pan American.

Two Exceptions

The Board took two exceptions to the carriers' recommendations—the omission of Trans Caribbean's participation, and the question of authorizing Riddle to carry non-scheduled cargo.

The CAB and Trans Caribbean should be granted operating rights for five years instead of three to permit full development of the route. A shorter period, the Board said, would not permit a fair test of the carrier's ability to conduct the operation.

As for Riddle's request to carry mail on a non-scheduled basis over its express all-cargo route, the Board decided to defer action until renewal applications for domestic authority are received.

Major reasons for turning Trans Caribbean for scheduled operations between New York and San Juan into the

airline's proposal to inaugurate tonight "360 Day" line of \$45 between the two ports and its improvement to the market as a supplemental carrier.

The Board turned down Capital and National Airlines' applications for the New York-Puerto Rico route on the grounds that "it is doubtful that portions of the required low fare service would yield the additional traffic and revenue support the carrier could rely on and because the route would require a major extension of its facilities to a route where there is no security."

The Board said it denied Riddle's application to conduct passenger operations because of the doubtfulness of such being the airline as an extension of its cargo carrier. It said United States Overseas Airlines' application was denied on the basis that Trans Caribbean's route in the market was more appropriate.

Eastern's Service

While the CAB found a need for service between Puerto Rico and other points in the U.S., it said it felt additional Eastern's Miami-San Juan certificate would suffice.

In making Miami an intermediate point on this Eastern's route the airline can provide single plane service between Chicago-Atlanta-San Juan, Chicago-Miami-Atlanta-Jacksonville-San Juan and Detroit-Charlotte-Charlotte-San Juan in addition to flights from major points such as Chicago, St. Louis and Detroit with a stop at Miami.

Under its former application to serve the Chicago-San Juan market was denied the CAB and, because of insufficient traffic to certificate another carrier at this time.

Board Member Louis J. Hunter concurred with the majority decision but took exception to one aspect. He said he agreed with the choice of Trans Caribbean to operate the service route between New York and San Juan but differed from the majority in its conclusion. He said:

"It does not fit me to conclude that Riddle should receive license to change course in order to deny its application here. To us, the fact of the 'all cargo' carrier is an important and difficult problem which requires careful continuing study. The desirability of maintaining this carrier as an extension of cargo carrier warrants a broad, sweeping conclusion not supported by the evidence."

Vice Chairman Charles Gurney disagreed with the majority on two issues. He approved the continuation of a third carrier on the New York route and the

and the selection of Delta for Chicago service.

The addition of a third carrier on the New York-San Juan route will do little to improve the service in this area," he said. "The existing carriers have provided unsatisfactory service, and through the years in the market we cannot have added the most cost-effective service as they become available."

As for the other route, Gurney said it has been the Board's policy in several cases to require the transportation of the smaller route to strengthen them, to make them self-sufficient and thus prevent their reversion to a subsidy status. He said the majority departed from this policy when it failed to require the Chicago market route be Delta.

IATA Fare Request Deferred by CAB

Washington/Atlanta on a proposed increase in fares between the U.S. and Havana and Miami has been delayed by the Civil Aeronautics Board with a new round of tariff dispute.

The increase was proposed by the International Air Transport Association and received unanimous approval of the governments of all air carriers operating between the specified points.

The resolutions adopted by IATA provided for an increase in fares between Miami and Havana and Miami and Nassau from the current level of \$20 to \$25 and \$20 to \$25. The increase would result in corresponding upward adjustments in points beyond Miami in the U.S. and Canada. In addition, CAB and the level of non-scheduled fares proposed by IATA were delayed with that for first class.

As proposed was a special 10-day round-trip excursion fare between Miami and Havana/Nassau during the off-peak period in January and February at a level of \$30, the same as present first class fare.

The Board said it was unable to approve the proposed fare increases because no discussion was made as to the need. No information in support of either the proposed first-class fare level or the non-scheduled level was received from the carriers, the CAB said.

At the same time, the Board had previously changed its policy on processing IATA agreements after receiving the public interest. It said it is unable to implement the changes of the time the Board acts on the basis of the resolution adopted at the IATA public conference in Miami recently.



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Competitive Route Across Canada May Be Outcome of Policy Review

By Glenn Garrison

Free airline competition across Canada may result from Canadian Pacific Air Lines plans to apply this month for a number of new routes linking Vancouver and Montreal. Canadian Pacific has had its eye on the transcontinental service for some time, but officials say that a government-owned Trans-Canada Air Lines is unlikely to run the route. Trans-Canada was founded in 1936.

With a change in government after elections last June, Canadian services for Canadian Pacific are expected to change, but the company is confident that the new Progressive Conservative government's policies will support a second transcontinental route.

The government has not yet decided its post-election policy. Minister of Transport George Drew is presently working on a policy regarding the licensing of air services in Canada, and has said he hopes to make a statement on the subject during the current session of parliament.

Competition Urged

Intensifying Canadian Pacific's drive to apply for the route this month found Chairman W. A. Moffat and his staff convinced that the time has come to satisfy the public demand for competition in service in Canada. Over 20 years of monopoly, the transcontinental airline says, if any, should be strong enough to stand up to competition in a postwar economy.

One application is in line with the basic principles of the late prime minister.

Another is the chairman of CPA's parent company, the Canadian Pacific Railway.

Proposed new patterns of routes would greatly duplicate only 10% of Trans-Canada's network. Since Canadian Pacific will add traffic rights to Vancouver, Montreal, Edmonton, Regina, Winnipeg, Toronto, Ottawa and Montreal, Vickers DC-8s would be available for the domestic service, Moffat said.

The airline would serve individual cities in various combinations, which officials would provide a pattern of basic route work.

CPA has been expanding its international service in recent years, including new services to Europe and Mexico (AW Apr. 22, p. 42). It has ordered Boeing 707s, announced no plans to bid for purchase of jets.

CPA has ordered the Douglas DC-8 as its straight jet replacement.

Canadian Pacific applied five years ago for an all-Canada transcontinental service, a route that was vetoed in the end, measures toward a national passenger service over the route. The Air Transport Board bowed down the application. Back in 1944 the airline asked five members of the board to look at the route, but they would not put together a route that would have amounted to cross-Canada service. This application met a similar fate.

The airline's timing of its present application is considered excellent. Some observers believe Canadian Pacific would make its move immediately after the election. Instead, it has waited ten months. Reason for this, according to Canadian sources, was to avoid interference of a controversial move until the government had worked out the first session of parliament, now under way.

With a clear post-election majority, the government will have faced the risk of conflict which would have divided it. If the Progressive Conservative faction were elected, CPA proposals would be right back where it started.

Now, these sources say, the government is fairly convinced with one exception, for all practical purposes, because Canadian airlines are seldom asked during the cold winter months. So the government is not likely to deal with Canadian Pacific's request.

If Canadian Pacific is awarded the route, there may be strong objections. The airline might be asked to operate some of Trans-Canada's unprofitable segments.

Government a Factor

The Air Transport Board is certain not to go on the application until it is advised of the government's policy. The board's decision has implications of such policy.

Periodically CPA's application will be reviewed by the board throughout Canada until it is seen by the board. It will then be determined whether public hearings are needed. If such is the case and the importance of the routes means that it will be the hearings, officials will be asked to present and then held in camera until.

If the board then approves the application, it will go to the Minister of Transport for his approval, which will be the final step.

On the international front, Canadian Pacific would like to run routes to such as London-Montreal routes. The

airline has a series of routes from Vancouver to Tokyo.

The London-Montreal service, inaugurated earlier this year, is being moved out of the route to Rome, which means the airline will be moved from a world service. However, there is no bilateral agreement between Canada and Italy, and now it focuses on the main route. The Canadian Pacific can ask the Air Transport Board for something the board hasn't got to give.

A third Canadian route, Pacific Western, also operates in seeking to get into the transcontinental air with service between Vancouver and Montreal. Canadian Pacific Western wants to fly on to the Caribbean, and it is to plan purchases of three Comet 3s if it gets the route.

Trans-Canada Airlines carried about 281,000 passengers on its transcontinental route in 1959. The first nine months of this year, however, since Toronto and Montreal accounted for about 167,000 of the total. Traffic between Toronto and Winnipeg totaled about 55,000 passengers. Other high density segments included Toronto-Gatineau, with about 15,000 passengers, and Toronto-Vancouver, with about 20,000 passengers.

CPA's first announced fare change to become effective Jan. 1. Toronto rates on transcontinental services by twice Halifax and Vancouver will go down 10%, putting them 35% below first class fares. Return fare reductions on first class services will be selected from 10% to 5%.

President C. B. McGeer says the changes will reduce average fares for passengers by 10% to 15%.

CPA also plans to make 15 more seats available on its Super Comets from service between Montreal, Toronto and Vancouver presently at first class rates.

Comet 3 Noise Tests Arranged for PNYA

London—Noise measurement tests of the de Havilland Comet 3 jet are now to be made at the company's Hatfield plant by the Port of New York Authority.

According to a statement of Bill Bennett, chief of operations, Cambridge, Mass., will conduct the tests on behalf of the Port Authority. A de Havilland spokesman said the company is now waiting for the tests at this time does not indicate any immediate plans for a U.S. sales test by the Comet.

"It is an obvious liability," he reports, "and obviously it is something we shall have to do for Capital Airlines and other U.S. airlines interested in the Comet."



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American Testimony Opens Fare Probe

By Fred Eastman

Washington—Airways in the local General Passenger fare hearings given first ordered in May, 1956 opened before the Civil Aeronautics Board yesterday. Ralph L. White testified with American Airlines the first of 11 domestic airlines to take the stand.

American President C. R. Smith headed a long list of witnesses scheduled to present arguments designed to convince the CAB that passenger fares should be increased.

Smith said the airline needs a rate of return on its invested capital, after taxes of about 12%, and that to it has that, fare should be increased in 1957.

He and the conclusion was based on advice from outside consultants and American's own studies and experience.

American is one of the nation's strongest domestic carriers financially, and its rate of return in the past has averaged the 12% figure at current fare levels.

Last year its rate of return was 11.5% as revenues and dollar rates reached an all-time high.

Shrinking Profits

Smith said, however, that last year also marked the beginning of a downward trend in profits which is due, he said, to inflation. He said that he had then looked to other enterprises with more stable earnings in which to invest their money.

Smith noted that American already has ordered 30 Boeing 707 jet transports and 35 Lockheed Electra turboprop transports in an initial step toward meeting the airline's future equipment needs up to 1961 (AW Nov. 5, p. 40). To pay for the equipment now in order, American has made arrangements to borrow \$115 million from the Metropolitan and Federal Life Insurance companies on floating rates.

At the time the loans were negotiated in 1955 and 1956, American said it felt safe in assuming its earnings after fixed charges and taxes would not fall below the \$18.538 million mark.

To complete its turbine equipment program, Smith said American would require 15 long-range and 25 medium-range airplanes in addition to those it took in order at an estimated cost of \$120 million including the cost of related ground equipment.

"We do not have the money,"

Smith said. "Our total net worth at the end of 1956 was only \$175 million, and it will be very little more at the end of 1957." At present, he said, he will suffer a loss in 1957 after payment of taxes.

Our cash flow through 1960—again at present fare levels, and even with our deposits on additional equipment orders—would bring us to seriously low points. By the end of 1958, current liabilities will seriously exceed assets as we continue to acquire a complete working capital position."

Smith said the only way American can attract the necessary capital to complete its program is through a reversal of the downward trend and an increase in earnings to a point where airlines can compete with other business for a share of available money.

Attracting Financing

John H. Eberle, a partner of Laurel Fenton & Co. investment banking firm and a director of American Airlines, testified to Smith the stand. He said the company required annual earnings of about \$25 million in order to attract the necessary financing.

This would not only permit the company to undertake additional borrowing but would place American in a stronger position to raise equity capital in 1957.

Eberle explained that on the basis of present earnings and forecasts of earnings, the most American could raise

in the way of additional capital over the next three years would be about \$25 million. He said lenders will be most reluctant to commit their money on a new project when they see that present assets are already considerably in excess than they were a short time ago.

To support both the present program and to have an hope for future financing of the additional program, Eberle said, "there must be a restoration not only of the average dollar earnings to the level of a year ago but as well a restoration of the atmosphere existing in the 1955-1956 period."

Alfano Speaks

Another witness appearing on American's behalf was Benjamin S. Clark, general partner of White, Weld & Co., investment firm.

Clark's testimony was devoted to an explanation of why airline stocks are not considered attractive for investment purposes in relation to other investment opportunities.

"The broad aspects of the problem are quite clear," Clark said. "Rising power is declining in spite of a strong growth in operations, and the decline is taking place on the very one of income capital needs. The net effect of all this has been to destroy the confidence of professional investors in the airline's future. This is shown tangibly in the drop in price of airline stocks."

The hearing is expected to run well into next week and has been divided into three phases.

The first, now under way, concerns the rate of return for airlines; the second will cover the impact of airline operations on the third side up remaining issues.

Cargo Line Asks Route to Moscow

Washington—Seaboard and Western Airlines last week applied to the Civil Aeronautics Board for permission to extend its transatlantic all-cargo route to Berlin, Warsaw and Moscow.

The present terminal points of the airline are Hamburg, Munich and Zurich.

At present Pan American World Air was the U. S. carrier to operate into the Soviet Union. A suggestion rather than a route in the Russian campaign that talks between the U. S. and the Soviet Union be started on a joint bilateral agreement between the two countries to meet material needs (AW Nov. 11, p. 42).

New Version of 707

Boeing-Boeing plans to offer a new design to airlines using versions of its 707 jet transport similar to those in the 707-80 prototype that has been flying for the last two years. The speed is scheduled to be over 500 mph.

To make way for the new aircraft, designated the 707-720, Boeing will abandon two earlier but similar designs, the 717 and 727 (AW April 15, p. 35). Many and full size and longer versions of the 720 will be approximately the same as that of the 707-80, and much of the aircraft can be constructed with production tooling already in Boeing's Renton plant.

Gross weight of the aircraft will be between 175,000 lb. and 200,000 lb.

The 720 is scheduled to include two models of the Pratt & Whitney JT3 commercial version of the JT3. Some 115 models are now producing 11,500 to 12,000 hp. Pratt & Whitney reports to have the dry thrust to about 21,000 lb.

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SHORTLINES

► **Allegiant Airlines** has acquired Civil Aeronautics Board approval of a second fare level for members of the elite. The fare, scheduled to become effective on Dec. 1, would allow passengers to fly at 10% of Allegiant's present first-class fares.

► **Aeromexico**, Colombia National Airways, will begin operating 11 flights a week from the DC-7 to Colombia on Dec. 1. Nine of the flights will originate at New York International Airport, two at Miami International Airport.

► **Boein Air Lines of Spain**, General Director, Cesar Concha Laca, says Boein's intent plans include service to Athens, the Scandinavian countries, the British nations, Cape and an extension of the airline's South American service to include Santiago, Chile and Lima, Peru.

► **Newark Airport** will be serviced by a new 54 million air cargo container. The Port of New York Authority has announced. The container, comprising four single story structures on a 29 acre site will be operating by the summer of 1959.

► **Pan American World Airways** reports a 17% increase in confirmed Atlantic cargo service during the first nine months of this year over that of the same period of 1958. The airline claims to be carrying 33% of the transatlantic air cargo total.

► **Southern Airways** flew 19,568 passengers plus 7,500,000 passenger miles during October. The airline, which recently boarded its one millionth passenger, reports a 10 month total of 181,400 passengers flew 51,983,000 passenger miles.

► **Swire** is offering a 15 day ski tour to the Austrian Alps for \$995.00 this winter. The airline also plans a team for winter team for January, February and March including 21-day visits in addition to the 15 day excursion to Swiss Alps and French mountain resorts.

► **TWA** World Airways will begin nonstop Lockheed L-1649 Constellation service from New York to Frankfurt on Dec. 5 with two flights weekly. On Dec. 1, TWA will begin nonstop flights to Zurich from New York and on Jan. 9 country service between New York and Madrid. This will have to curtail the number of European cities served by nonstop TWA flights.

AIRLINE OBSERVER

► **Airlines** are beginning to feel the pinch of defense cutbacks (ENR Sept. 30, p. 47). Decline in travel by subcontractors has caused World Const traffic to drop and has been particularly noticeable in Western Air Lines operations between Los Angeles and Seattle. Boeing, with headquarters in Seattle, has advised its people to use coach flights rather than first-class where possible. Widespread acquisition of such a source by the defense industry could cut an even deeper ditch into airline revenues.

► **Australia Airlines** is converting 10 of its standard first-class DC-7's into executive configurations and expects to complete the modification by the first of the year. Move is designed to increase flexibility in scheduling aircraft and to expand flight frequency of both tourist and first-class service.

► **Work** for an automated mail campaign by Douglas Aircraft for its DC-9 medium range turbojet transport. Douglas wants a new airplane for jet operation at its Santa Monica plant more engineering on the DC-6 and DC-7 series will be complete in three months, and the end of the production line will soon be in sight. No building on the Santa Monica property is large enough to hold the larger DC-6 long stage turbojet transport.

► **Pan American World Airways** has been denied to Madrid and Lima, New York to Johannesburg via Madrid because the Spanish government continues to stall on giving the new routes its approval. During talks with the U. S. State Department in October, the Spanish government asked for time to study the proposed Madrid stop before granting Pan American a permit to operate the route. Some time observation on beginning to feel that the stall time from a fear of two month observation for state-owned Iberia Air Lines of Spain and may continue for some time.

► **United Air Lines** will be operating an all-jet fleet by 1965. The plan contemplates the purchase of 92 additional turbine aircraft in addition to 30 DC-7s now in order. The aircraft has definitely discarded earlier plans to include turbojet transports in its program. Fleet will consist of 33% long stage equipment, 45% intermediate range and 22% short stage aircraft. First stage of a \$12 million expansion program at the airline's San Francisco base will begin shortly with the construction of a jet capital terminal here coupled with a 10,000 sq. ft. expansion of present facilities at a cost of \$4 million.

► **British government** has rejected claims that noise and vibration of a Broomfield 101 turbojet transport damaged seven houses during recent tests. London Airport on Sept. 8. Accidents closed the airport, on a diplomatic mission, caused shattered windows, cracked roof tiles and fallen plaster during a blizzard that created a "great noise and disturbance." The government reported that an independent investigation showed that damage "not of long standing and attributable to causes other than aircraft."

► **Trans World Airlines** plans an accompanying the airline's sales representatives in calling on Korean City businessmen as a volunteer team. Purpose of the experimental plan is to help represent American products with the technical aspects of airline operations.

► **President's Assistant Elwood Quesada** will begin public hearings Monday on but also for a second Washington report. Quesada has announced the selection to first possible locations—Miami, Chicago and Portland in neighboring Virginia and Baltimore Friendship Airport.

► **Famous Air Lines** has leased three DC-7's from United Air Lines and an Lockheed Constellation from Trans World Airways and will, 1958, to handle Florida winter traffic. Lancia will operate the DC-7's in first-class service and the Constellation as 75-passenger aircrafts.

► **Capital Airlines** and Shell Oil Co. have renewed their turbine deal contract for a first year period. Estimated consumption of the 640 acre-feet will run approximately 30 million gallons annually.

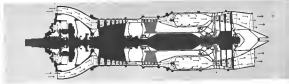
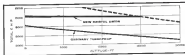
BRISTOL: Power for the Wings of the World No 2



The Bristol Orion is now undergoing development flying in the Bristol Britannia

MIGHTY NEW BRISTOL ORION:

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Focus on the mighty new Orion

A two speed constant-power turboprop. Take-off rating, 5,100 hp.

Orion's two compressors. Work split between low and high pressure stages is arranged to allow both stages to run near maximum adiabatic efficiency. The two speed layout also leads to unprecedented flexibility of operation.

Advantages of "Bleed-Off." Orion is an 5,800 horsepower engine delivered thrust at sea level. At 30,000 feet and sea level maximum power it delivers 3,000 hp. By restricting output to 5,000 hp, Orion was level up to 35,000 ft, propeller and reduction gear can be lightened—giving marked reduction in specific weight.

Yet the take off at high temperatures or elevations, the Orion can be given its head by simply opening the throttle—water injection and other power boosters are unnecessary.

Proven low economy. Specific fuel consumption of the Orion is at under 1.40 lb/hp/hr. The phenomenal economy makes it possible to achieve longer, low cost transport of high payloads.

Orion powered aircraft could operate at 200 mph—displaying journey times competitive with pure jet—yet at a fraction of the cost.

Two turbine Bristol engine family. Bristol Aero Engines Limited also produce the well tried, monospeed Proteus turboprop—powering the Bristol Britannia, the high power, low consumption Olympus turboprop, the lightweight Cyclone turboprop, the Thor engine—in production for the Blackburn S.A. II. Constant research activity ensures that Bristol will continue to lead in bringing power to the wings of the world.

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...to familiarize CAA personnel
with jet transport operation

Playing a leading role in the transition to the jet era, the Civil Aeronautics Administration has selected an electronic jet Simulator to be designed and built by the Electronics Division of Curtiss-Wright Corporation. Among its many missions will be the training and familiarization of CAA air carrier inspection personnel in jet transport operations, including all phases of surface flight crew training... and the study of approach and holding procedures for improved air traffic control in the jet era.

At the same time, the CAA will take advantage of another dimension in the realism of flight reproduction—Curtiss-Wright Dehmel Visual Aid Simulation Equipment. This new Curtiss-Wright equipment consists of scale models of specific airports, and a mobile television camera which responds to the pilot's control—enabling him to rehearse landings and takeoffs under VFR (Visual Flight Rules) conditions.

The airport environment, buildings and runways are realistically viewed by the pilot, on a large screen, in their true relationship to his attitude, position and approach.

Simulators by Curtiss-Wright have been produced for nearly every type of advanced civil and military aircraft. They have a long background of proven service, including extensive use by the CAA itself. Every fully electronic Simulator used by U. S. airlines today is a product of Curtiss-Wright.



AERONAUTICAL ENGINEERING



OLYMPUS 11 turbojet has NATO light fighters in less than 3 ft. dia., slightly more than 6 ft. long. Thrust weight ratio of the engine is 5.9. Engine has seven compressor stages, a variable combustion chamber and a single-stage turbine. Dry weight of the engine is 325 lb.

Light Orpheus Jet to Power 11 Designs

By David A. Anderson

Bristol, England—British engineers in seven countries are being back armed by the Bristol Orpheus lightweight turbojet developed for the NATO light fighter program.

Under a contract with the joint NATO Weapons Development Program of the NATO countries, Bristol is developing and building the Orpheus 11 and its successor the Orpheus 12.

Orpheus 11 powered the Breguet Twister, Dassault F4D Skystar 6 and the Fiat G91 through the comparative engine test trials at Bruggen last month (AW Oct. 28, p. 50).

The earlier Orpheus 9 engine is being in the Polaris Cruise and in the Lockheed Jetstar. In both, the Orpheus engine is scheduled to get an Orpheus 11 from the Fiat TIF 11 is being developed around the Bristol engine. Spain's Hispania HA 500 delta-winged interceptor and a Yugoslavian project incorporate the Orpheus.

In the United States, North American Aviation Inc. has specified the engine as an alternate powerplant for its 246 transport and its T27 trainer for the Navy.

Built Under License

The engines will be built in India under license. The French firm of Snecma has a license for its Orpheus development. FiatSVA in Italy has a license for a license and Curtiss-Wright in the United States has a license to build the engine as the T27.

All five started with engineering per-

ception at Bristol. First there was the perception of the need, it didn't exist at the time, but soon Bristol people thought it would. Second, there was perception of the way to meet the need in the design of a rugged light weight engine that would be suitable for a variety of light fighters.

Bristol's detail design work and the fast reworking of the engine are reported in time, by less than a year, which must be some sort of a record for a lightweight turbojet.

Basic rating of the current engine,

the Orpheus 11, is 4,500 lb. static thrust. Dry weight of the engine is 325 lb. and the thrust weight ratio is 5.9.

Engine Description

The Orpheus series of engines is built around a seven-stage axial compressor a stainless steel combustion chamber having seven individual flame tubes and a single stage turbine. It uses about one-third the number of parts as a conventional engine. The overall engine dimensions of the engine show a ratio



CONTROL and accessory package of Orpheus 11 is located on underside of engine at forward end of compressor casing, for easy access in field. Simple construction was a design outcome



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Orpheus Engine Specifications

Engine	Orpheus 1	Orpheus 2	Orpheus 3	Orpheus 4
Rated Horsepower	4,500	4,500	4,500	4,500
Displacement, in.	22 1/2	22 1/2	22 1/2	22 1/2
Length, inches from intake	72 1/2	72 1/2	72 1/2	72 1/2
Weight, lbs.	750	825	880	1,025
Rated weight	3.7	3.9	4.0	4.6

overall width of 32 1/2 in. a maximum height of 34 1/2 in. and a maximum length of 96 1/2 in. Nominal diameter of the engine is 22 1/2 in. and length from the flange of the intake to the flange of the exhaust is 74 1/2 in.

The overall diameter of the compressor is constant. The air discharged from the last stage passes through a third stage into the delivery casing which is the transition section between the compressor and the combustion chamber housing.

Each of the seven internal flame tubes in the combustion chamber leads to a chamber which is a section of a series of tubes integral with the case and the single-stage turbine of the compressor.

Each of the seven internal flame tubes in the combustion chamber leads to a chamber which is a section of a series of tubes integral with the case and the single-stage turbine of the compressor.

Each of the seven internal flame tubes in the combustion chamber leads to a chamber which is a section of a series of tubes integral with the case and the single-stage turbine of the compressor.

Accessory Power Drive

Best place of the main compressor shaft drive, a vertical shaft, is the accessory and control package under the engine.

All blades are precision forged to meet the high standards of the engine.

Compressor blades, discs and stators are made of light alloys. The intake casing and the compressor casing are made of aluminum-magnesium alloy and the delivery casing is aluminum die.

In the hot section, the flame tubes are made of Nimonic 75 and the turbine stators are made of Nimonic 90. The turbine disc is H-16 turbine stainless steel and the blades are Nimonic 90. Exhaust cone and jet pipe are made of Nimonic 75.

The increased performance, expected in the Orpheus E2 development will undoubtedly call for some changed material specifications.

The Orpheus 1 engine is a development engine for ground and flight test work. Thirty nine of them are built.

Orpheus 2 is the engine for the Polaris boat. Its drawback is that the fuel pump specified for the engine was a Lucas Type B which does not supply enough fuel to enable the engine to make its full rated static thrust rating. The fuel pump for the engine is a 4,000 lb. But in the engine class the engine comes up to its potential and at altitude a putting out the thrust equivalent to a sea-level rating of 4,500 lb.

Production Version

The Orpheus 2 engine in production carries the designation of Orpheus 700. A development of the engine is the Orpheus 701, for high-altitude applications. The basic Orpheus engine was not intended as an intercept power plant but recent thinking has been along these lines for the Polaris boat and other aircraft. Although the basic design covers the same for both engines the 701 has better altitude capability than its immediate predecessor and has been flown up to 15,000 ft in the Polaris boat.

Developing the engine for altitude performance can only be done step by step due to the generation of the powerplant. Small size means small thrust and small thrusting. Reynolds numbers drop in the range where and a more critical and more work required. Each development brings increased thrust at 40,000 ft and thrust is greater at operating points below the step limit.

While trying to solve these problems Bristol engineers also were working on other intermediate changes within the engine and quite in constant demand upon a Bristol jet that resulted from an entirely different line of a complete part of the engine.

Food dipping was incorporated into the high-altitude engines as a result of the experience reported by both Bristol and government. Bristol's Harrier. The problem was that gas flow in the Harrier

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USAF Cancels J91

Washington-Air Force has officially announced cancellation of its contract for development of Pratt & Whitney's 21,000 lb thrust J91 turbojet engine, which was scheduled to power an aircraft shown above.

Plans for cancellation or withdrawal of the project had been known for some time and in August Pratt & Whitney warned its stockholders that the program might be "possibly characterized critically" (N.W. Aug. 19, p. 34).

As Fincis said, that its contracts with General Electric has a second power plant deal with Corvax and Lockheed for delivery for the steamships project were still in force.

blew out the engines, and the haul came to that. The engines were operating too close to the range line. Gary Mast given, sucked into the engine in his, released the anchor at low positions in effect producing hot air conditions within the engine. The power dropped but the fuel flow, corresponded to a high power condition. Barging was the result and the engines blew out.

The cure was a simple one. A switch in the gas-firing circuit reduced heat flow just a split-second before the gas fired, with reduced heat, the engine-governer valve dropped naturally and the margin between it and the surge line widened. Blow-out stopped. Now the Coast's gas can be fired right up to 45,000 ft.

Appendix 2 Controls

Use of the Gnat as an outstation produced a pair of additional controls for the Oryx 2. An altitude acceleration unit is now being installed on the helmet, and also a pressure rate control which keeps the eyes automatically below the stage line in gardens of light conditions. Another line from light aids to evertion point at altitude, using the rate control is expected to be about four seconds.

NAFEO's engine is the Ophion 3, being developed under a contract costing procurement of 60 engines. Originally within its life, the Ophion 3, through its type test, the contract has been extended to cover the development of the engine, to the Ophion 12 including its type test.

Although the specification for the light fixtures calls for their use as a ground/support pole at various altitudes below 5,000 ft, the recent tests at Bechtel were conducted under the supposition that successful rigging operations would have to be shown at 30,000 ft.

The carrier is also required to own

AVIATION WEEK, November 25, 1957

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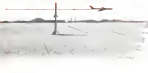
EDISON'S SIZE 8 GEARHEAD MOTOR



OPERATING CHARACTERISTICS

- Type of motor: Two phase
- No load speed: 3400 rpm
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- Stalled torque: 100 in. lb.
- Power input at stall: 1/2 hp.
- Break watts, phase 2: 7
- Speed at max. Power output: 3400 rpm
- Torque at max. Power output: 100 in. lb.
- Thermal protection: at stall, 30.000 rpm, 100 in. lb.
- Fully continuous at stall

smallest diameter gearhead available, yet motor gives same output as a size 10 unit



The Edison Inherent Design has met the challenge of greater miniaturization in gear motors for aircraft and missiles. The size 8 Gearhead Motor shown here is a typical example. This particular Edison unit can be supplied in any gear ratio within 2% and has the smallest diameter gearbox ever available. It is the only unit in its class that has the same output as a size 10 motor and yet has an ideal motor for its own miniature size. It is the only unit in its class that has the same output as a size 10 motor and yet has an ideal motor for its own miniature size. It is the only unit in its class that has the same output as a size 10 motor and yet has an ideal motor for its own miniature size.

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ate for 25 sec. with the engine in an inverted position.

The Gephys 7 was a Lucas Type D fuel pump but otherwise has no similarities to the conventional European standard. It develops 4,750 lb. sec. local static thrust at 9,000 rpm. Specific fuel consumption is just over one lb. per lb. of thrust.

Devoted Version

In its devoted applications, the Bristol engineers have designed the Gephys 8, a devoted version of the Gephys 7. Thrust of the Gephys 8 is approximately 4,700 lb. The purpose of devoting has been to lower the operating temperatures and thereby increase the life of the engine. First test of the Gephys 8 indicated it is a powerplant for the Coast two-seater biplane. Since then the light fighter compares have presented three versions of two-seat fighters for their fighters, all powered by the Gephys 8.

Designations of the engine class from Oe 8 to Oe 11 reported as a development engine for the Oe 12. Thrust rating of the Oe 11 is 5,700 lb.

The Gephys 12 is a somewhat different engine. It is a larger, heavier and produces 4,000 more thrust. It has an increased air intake flow. Its thrust rating is 6,500 lb. and with Bristol Sme-

SAC Bombers On Runway Alert

Post-American strategic bombing have been on runway alert since the clock has been set.

The SACs are now in the line. Gen. Thomas A. Power, Chief, Strategic Air Command, Gen. Power met with the SACs after briefing them on the new NATO action plan. He said that the SACs are now in the line. Gen. Power met with the SACs after briefing them on the new NATO action plan. He said that the SACs are now in the line. Gen. Power met with the SACs after briefing them on the new NATO action plan. He said that the SACs are now in the line.

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phased (Bristol BSR), the thrust is increased to a static value of 5,370 lb (two-fold).

The engine will undoubtedly turn out to be the crown capstone for the NATO light fighter program of that program number tangible outline. The reason is that none of the recent engine layouts designed for the applications can meet the thrust requirements. View Bristol is the only one out.

In one typical case, the Dassault Bréguet 4 has been redesigned for the Olympus 12 engine. The increased thrust meant an increase in fuel tanks and without more. The increased thrust meant that more fuel must be provided to meet the NATO engine profile. Luckily, Dassault found the extra fuel could be included within the increased dimensions of the landing gear bay.

As the installation of the Ch. 12, the reported changes in length and most flow but it possible configurations changes is then the engine. For example, the compressor stages might be increased as needed in another engine, stage might be added. Bristol went so far that the new engine is going to be built, we will it so when it is expected. But other variants indicate the engine should be running by June 1958, judging by Bristol's development time for the Olympus series. This schedule looks pretty good.

Olympus History

Background of the Olympus line is rather complicated. It was not designed for the NATO light fighter program but rather developed to meet the requirements of the program.

The Olympus originated as an experimental engine for a pair of expendable bomber projects being developed by Bristol and Vickers. The engine program was first done in 1951, a total of 1,000 lb. static thrust. Bristol's weight was more than 100 lb. and with no accessories. The thrust weight ratio was six, driving, which was a fairly good design for those days.

Bristol began work on an engine designated the BR. 17 but soon ran into the most common engine problem, weight and performance. The expendable features of the engine, which the total low production cost were not compatible with the required thrust weight ratio and the performance. Although the engine could be an all-welded structure for production use, but unfortunately it would have to be welded in manufacturing tolerances in order to produce the thrust.

Bristol decided on a more orthodox approach to the problem but decided to return to more features of the expendable engine design as possible. This proposal became the Bristol BR. 22 but was not a 5,000 lb. thrust and was the original engine W.F.W. Parker chose.

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Welded Tubing**

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to the propellant for the Felted Gun light engine.

But the requirement for the expendable launcher was canceled and right after that so was the Saturn engine, for lack of funds.

Boosted engines under Dr. Strafer G. Hockett's commandment that such an engine was going to be needed and look further out at the whole problem of providing a lightweight, high-thrust engine. It also has led back exposed to the design thinking of Foster and led to the growing stage of industrial opinion behind the light-weight lighter concept.

So Bristol made the decision to develop a lightweight engine of the type, based on the feeling that something was going to need one (like soon). This came with the coming situation just off, because it probably was the future availability of the Orpheus engine more than any other factor that determined the final requirements for the NATO light engine.

Final design studies for the Orpheus were begun in 1957, and stemmed from one of Hockett's suggestions. He proposed making the big pressure compressor from the Orpheus supercharged turbo-prop engine then under development at Bristol and building a lightweight engine around it. This became the design proposed for the EE-28 Orpheus as it happened, the Orpheus was an operating engine before the Orpheus.

Development Schedule

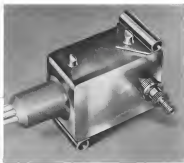
Detail design started at the beginning of 1954 when the first manufacturing drawings were made in the shop in January. By testing of the component, testing and other components began in the fall of that year. The first Orpheus prototype engine was started and ran on the test stand Dec. 15, 1954 less than one year after the start of detail design.

This engine, like prototype engines constructed was derived during its early development life. By May 1955 it had completed a 150-hr. type test at 1,235 lb. thrust and was cleared for flight.

The first flight was made in the prototype Felted Gun July 10, 1955. Type test followed type test. The Orpheus B Ch. 1 passed at 4,070 lb. static thrust in January 1956. In November that year the second development of the basic engine, the B Ch. 2, ran through at 150-hr. maximum at 4,520 lb. and reached thrust over 5,000 during the test.

The Orpheus 3, intended for the NATO engine, was type tested in May 1957 at 4,510 lb., the guaranteed thrust for the engines of the light engine program.

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The new KLIXON C9178 rotary hermetic switch is designed for such precise applications as aircraft landing gear controls, guided missile launchers, engine equipment, engine controls and industrial equipment.

A double pole, double throw rotary assembly, the C9178 has two 1000-ohm Type I hermetic sealed switches enclosed in a steel case to withstand heavy impact and corrosive fluids.

The model eliminated two 300-ohm resistance reactions and is designed for positive action in both clockwise and counter-clockwise directions. Other parts are available with limited rotation and/or spring return. All models can be provided with connectors, gasketed leads and separator arms designed to your particular specifications.

Technical data sheets on the C9178 and many other types of hermetic and non-hermetic switches are available. Write for PF9W Catalog.

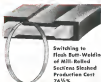
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RINGS ROLLED & FLASH-BUTT WELDED from a Mill-Rolled Section



Switching to Flash Butt-Welding of Mill-Rolled Sections Slash Production Cost 74 1/2%

SAVED \$220.63 EACH

A ring originally designed as a casting weighed 399 lbs. and cost \$169.00. Later it was purchased from Armco, as a rolled and flash-welded ring made from a cast-rolled mill-rolled shape. More than triple savings resulted. Since cost dropped to \$59.37 and weight was reduced to 94.5 lbs. In addition, considerable time and money were saved in the finished machining operation.

SAVED \$103.46 PER RING

Rough rings purchased by a well-known manufacturer of aircraft engines weighed 355 lbs. each. Most of this weight was unnecessary weight that was machined away. American Welding's Industrial Products Division, working with this company, studied the product and recommended a flash butt-welded ring, formed from a special mill-rolled shape. Adopting this ring saved 68 lbs. of metal and eliminated much of the machining time required.

American Welding can help cut costs in your plant by suggesting the use of steel rolled and flash-welded from mill-rolled or extruded shapes.



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AMERICAN WELDING

The World's Leading Manufacturer of Welded Rings

series of Olympus is about 8,000 lb. on with about 500 of these light base and the rest mounted below. Current airplanes flying with the Olympus include the three NATO fighters—Breguet T-37, Dassault Standard 6 and Fiat G-91—Rolland-Guest, Lockheed Jetstar and Aerojet test bed.

Next Olympus to take the air will be a North American F-56 Sabre, modified as a flying test bed. The plane should fly before the end of this year. Now the basic decision on which Olympus and how many engines to come from the final evaluation of the NATO light fighter competition. It is almost a certainty that no Olympus 3 engines, beyond the original 60 of the Mutual Weapons Development Program, will be ordered. The first engine for the light fighter project will be the Olympus 12. But the number depends on the number of fighters ordered, and that is still to be set.

Those airplanes other than the NATO fighters which use the Olympus 3 will undoubtedly shift to the Oe 12 when it becomes available.

May Face Boom

Should the NATO order be placed, Bristol would be flooded with work, on literally thousands of engines. There is the possibility that the Olympus would be produced in another plant than any other turbojet except possibly the General Electric J47 and the Rolls-Royce Avon series.

There is also the possibility that the engine would die quickly with the death of the NATO program, because proposed alternate orders are few in number and would decrease if Mutual Weapons Development Program funds were cut off.

Bristol is in good shape to back the engine production that could come its way, although a tremendous order for NATO engines would probably be political and technical success. In spite of strong Bristol, Saucan and Fiat.

With everything to gain, Bristol's engineering people of 1957 is making the profit stage.

Soviet Public Relations

Moscow—Moscow is going all out to try and shake off propaganda labels from its rapidly-growing fleet of high-speed helicopters.

Sovets recently flew a large helicopter to Moscow. Correspondents to picture a construction job below the cost of the flying officers. In five flights, the craft lifted 1.5 metric tons of steel parts to the top of a new building. Then, the Russians proclaimed, "in five hours a Soviet helicopter accomplished work which a lifting crane could not do in five days five months."

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CONVAIR SELECTS BENDIX LIQUID OXYGEN SYSTEM FOR B-58 HUSTLER—America's First Supersonic Bomber

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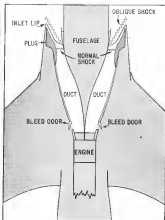
With a plane such as the Mach 250,000 F-7 in this state a conventional reaction controls which run high energy gas from small rocket motors are located in wing tips and nose. Control is produced by generating signal accelerations to roll, pitch and yaw. Development of an automatic control system for the type of vehicle control is now underway in projects at Honeywell Auto.

Honeywell



Military Products Group

Automated Division • Defense Division • Business Division



F-105 INLET In engine refers, is cut back to make it enter the stream at which leads up behind the shockwave as it moves back into the inlet to spill over the top and bottom of the inlet. Movable plug inside holds the normal shock, sets it inside, at best position.

F-105 Engine Inlets Efficient, Reliable

By Robert Costanza

New York—Inlets for Republic Aircraft's F-105 show recent trend in external-type inlets for aircraft above Mach 1.4.

The F-105 inlet is one of the first examples of a mixed configuration designed by Dr. Antonio D'Amico, head of Brooklyn Polytechnic Institute's Department of Aeronautics, Engineering and Applied Mathematics, when he was at National Advisory Committee for Aeronautics, Langley Research Station.

The F-105 inlet has the advantage of combining the efficiency of an internal compression shock intake with the more reliable handling qualities of an external type. While it is probably not much more than Mach 2 in the F-105, it was the type of inlet chosen by Republic for its advanced F-101 before that aircraft was canceled. The F-101 is believed to have been

planned for Mach 3 flight (AW Sept. 9, p. 101).

Comparing the F-105 inlet with the 358 inlet (AW Feb. 14, p. 31), it can be seen that the F-105 inlet is not an oblique shock intake, but this also is made out in plain view.

The first shock starts from the inlet side instead of coming from a ramp alongside the fuselage, as it does in the Lockheed F-104 inlet.

Feint Oblique Shock

At first, because the F-105 inlet displays the same oblique plus normal shock pattern it might appear that it too is an external type. However, the difference is that in the F-105 inlet the oblique shock is feint and is a result of a configuration to get the normal shock inside the inlet. In the other two inlets the designers have tried to make each shock about equal

strongly to each other the job of reducing the impedance contrast to subsonic values acceptable by the engine's subsonic compressor.

A Republic engineer told AVIATION WEEK that the oblique shock does only 5% of the compression work of the inlet system, while the normal shock does the rest.

A pure internal intake would add another upon a single normal shock inside the inlet (Fan, Drift and Thomas Solopuk of Lockheed Aircraft Corp. pointed out in a paper before the Institute of Aeronautical Sciences that even though an all internal inlet system would be superior especially at Mach numbers over 2, apparently no designer has discovered a practical means for starting such a system).

Fern explained the problems of this type of supersonic inlet in his Patent 2,758,245 recently granted but filed in 1955.



CURVES by Lockheed engineers show an 8 percent loss that internal inlet, because of lower inlet drag, are 20-30% better than external inlet at the Mach 2.5 region. Throat to drag after the two types are plotted against Mach number. Additional variable K represents ratio of inlet drag for most common inlet to that of two-dimensional inlet shows that plug type is superior to duct type.

For maximum pressure recovery, the perfect inlet, an inlet is provided with a continuous downstream of its leading edge. When functioning properly at supersonic flight speeds, the inlet flow upstream of the inlet lip is supersonic, while downstream of the inlet throat the flow is subsonic. In this condition the inlet is said to be started. However, the problem is to get the inlet started. For the inlet to start after some flight speed is exceeded, the F-105 inlet has a strong shock wave which reduces the supersonic flow from the subsonic inlet mass from the inlet entrance (where it will of course flow as the aircraft comes up past Mach 1) down the inlet to the throat entrance.

The mass of air that will pass through the inlet will be greater in the started condition to that during starting, part of the air downstream of the strong shock wave will spill outside the inlet as it moves back.

The mass of air that will pass through the inlet will be greater in the started condition to that during starting, part of the air downstream of the strong shock wave will spill outside the inlet as it moves back.

Inlet Flow
Fern pointed out that because a wide, wide inlet would have the greatest spill area, it would be the easiest to start. In the case of the F-105 it can be seen that flow can spill over the top and bottom of the wide narrow inlet while the first shock is starting back.

After the first shock has moved back, the first oblique shock created by the curved edge of the forward pitting inlet will have.

In the particular Fern patent referred to, Fern and the variable with wide narrow inlets such as are indicated into the leading edges of the wing roots on the F-105, is that the wing drag is high. In his patent he therefore proposes that a series of these forward pitting inlets be so grouped side by side that the system there that ing advantage but prevent lower drag configuration for the aircraft. This is let into an inlet would be divided into a series of smaller pitting shapes which are suggested to split their outflow into such other, outside inlets.

Over the F-105 inlet system is started a further refinement of a new system means the subsonic inlet entrance is used to reduce the flow. This restriction compresses the air before in aircraft speed upstream and causes operation downstream. Hunting bleed doors further downstream just ahead of the engine add to the inlet's ability to handle flow transients.

Reliable Controls

Lear Inc.'s Grand Rapids, Mich. Division which makes the control and actuation devices for the F-105 thrust restriction plug says it has perfected an especially reliable system.

Unlike the B-55 inlet control system, the Lear F-105 system controls the variable inlet geometry in a passively open, low velocity volume. The plug position is scheduled from the aircraft's flight Mach number. The B-55 used a higher closed-loop control moving directly up and down from passively moving probes extending from the inlet lip into the external shock waves.

Lear says it has avoided pressure probes because of the difficulty of obtaining signals at higher Mach numbers. Lear engineer William Smith told

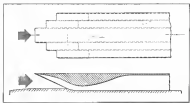
AVIATION WEEK it is important that the inlet controls be reliable. Critical conditions which could arise if they are not.

- **Overtemperature** of the engine hot lines from shock heating if the plug is moved to a wrong position.
- **Large sudden drag load** on aircraft with attendant loss of engine thrust output if flow upstream and plug goes to subsonic.
- **Difficulty of handling** aircraft if plug sticks in supersonic position.
- **Complete loss of performance** point out of aircraft if plug sticks in subsonic position.

Fuel Save

Smith said that the aerodynamicists indicated it would be a serious failure when the controls were asked them, but would result from upstream malfunctions. The Lear system, and Smith's is designed to always be able to see, selected position.

Lear also developed and is producing inlet controls for the Convair F-106. The F-106 inlet appears more conventional and uses an adjustable internal restriction on the fuselage side of the inlet duct.



STACKED ramp inlets created by Fern reduce low drag competition with any start ing capability. Middle ramp splits flow out to back ramp on either side.

ENGINEERING REPORT

A Case History of Environmental Control

PROBLEM

VIBRATION • SHOCK
AND COOLING

POWER TUBE FAILURE during environmental testing of the Servo-Amplifier in the flight stabilization system of Chance Vought's F8U-1 Crusader.

SOLUTION



ENGINEERED MOUNTING SYSTEM

Robinson Model 1054 air-cooled light-weight mounting system to protect entire Servo-Amplifier assembly. Highly damped Mus-U-Flex resilient elements are incorporated in an approved mounting design. Resulting material greatly suspension system assures all attitude protection for power tube and other sensitive components.

The Servo Amplifier assembly was tested with six shocks in over 60 separate operations.

SPECIAL FEATURE:

Range of environmental protection is extended by screened cooling aperture designed as part of the combined shocks and mounting.

PERFORMANCE:

Natural frequency of the mounting system is between 10-20 G.P.S. After 10 G shock tests on all six sides, there was no loss of isolation efficiency which remained as high as 90% at 100 c.p.s. with 500 mbars exposure.

RESULT:

1. Increased operational reliability of Chance Vought's experimental Crusader.
2. Another contribution to the weapons system reliability program planned by Chance Vought Aircraft, Inc. in cooperation with Robinson engineers.

ROBINSON
AVIATION, INC.

Teterboro, New Jersey
West Coast Engineering Office, Santa Monica, California

ROBINSON CONTROL IS RELIABILITY CONTROL

may have little in common is a risk of technical requirements remain the same.

Crank programs comprising behavior of components and their defect must be computerized too. One promising way, according to Schilling, is to make informed inspection to uniform parallel developments in component fields or even with whole systems.

In the case of handling tools the purpose of creating a self study level, selection of potential solutions from which to choose. Schilling said.

Rate of operations research was discussed by H. J. Merv, chief engineer research, Texas Instruments. He pointed out that operations research provides a continuous evaluation of the effectiveness of a weapon system in its technical environment all through the system's development period.

Throughout the meeting analysis of weapon effectiveness. Merv said, the main emphasis is the isolation of the weaker links in the weapon system chain and investigation of possible ways of improving them during the design development period. In addition to this technical function, operations research has become a valuable tool for management to use in making plans and policies. For example, Merv cited the use of Texas Instruments' operations research to review future studies, present analysis and the changing balance between armament and man (AV Sept 8, p. 75).

Merv said that in order to be effective, operations research tools must serve in all relevant information—self study time is free as possible from such solutions to do objects research and facilities to make recommendations in this way then regardless of current or projected needs.

Rule in Reliability

In the field of electronics, the intense success or failure in quickly changing high reliability is primarily due to management, according to L. W. Lohry, research director electronics, work and development staff, Texas Instruments Corp. Lohry said that his experience with the industry design of a number of research electronics system indicates that success is more a function of management structure and characteristics than the average caliber of engineering talent.

Management's responsibility is to recognize the problem, define the problem to its people and see that they are adequately equipped in the past experience of others with the problem. Lohry said.

Management should also see that a detailed and scheduled approach is made in the problem with many feedback loops going to those whom the program manager has seen are responsible and

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like, to take iterative action in correcting difficulties, he said. Management should also provide staff assistance.

The engineer who understands who gives specifications is successful, who along with his superior, sees his staff equipment did under circumstances but immediately after it has left his hands, will be lost to correct the fault? Latham said. But the engineer who does not understand the reason for the specification, who is provided no opportunity for the elimination of trouble, and who hears, perhaps months later, that someone has alleged that his equipment was the cause of a major flight failure, is quick, only in deciding his position in the initial design of the equipment.

Need for Research

When the program manager has things under control and has shown the engineer his responsibility, he spends some time on advance thinking. Latham pointed out. Then the manager can anticipate the need for research in making the equipment lighter and cheaper and he can see there is some sophisticated work to be done in short months and packaging concepts. And he has the background to tell this program to the government. Because he also sees that his effective management action is as essential part of any practical redesign program, Latham said.

Participating program for the high performance B-58 weapon system was discussed by Robert Kahn, manager Material Department, Convair F-75 Wichita Division. He pointed out that the performance specifications of the B-58 created new problems for the vendor involved in developing sub-systems for the new bomber. Since the super sonic B-58 weapon system, involved some new concepts and new requirements in sub-systems, Kahn observed that it was important for Convair to choose computer models verified for these sub-systems. Trouble was caused through an elaborate program that as valued visit in, leaders to Convair F-75 Wichita and with its Convair evaluation team to conduct plans.

Kahn said that one of the problems Convair faced was one strong feeling that the company did not intend to meet vendor fields in producing the B-58 under the single manager concept. He pointed out that if it costs out all over, dollar in the B-58 program goes to sub-system vendors.

Integrated design can produce more efficient cooling systems for cruise and electronic equipment in high performance aircraft, according to P. E. Petty, operations engineer, Chance Vought Aircraft.

Petty said USAF designers that cruise and electronic cooling systems of high

performance. result can be integrated into a single efficient system of cooling characteristics of the cruise and electronic equipment are designed to be compatible and are attached to the aircraft performance envelope and if the system is installed so that it can take advantage of every available flow before occupying the cooling system in cruise.

Cooling Answer

In developing an integrated cooling system for both the cruise and electronic gear, the cooling system designer can often show the superior and manage the advantages and disadvantages of spending more and effort in designing an electronic equipment to improve their cooling characteristics, Petty said.

The approach not only can solve the aircraft cooling problem, but it can greatly reduce the magnitude of the electronic equipment designer's cooling problem, resulting in a better, more reliable equipment, Lister, he said.

Petty warned that if the cooling system designer does not establish his system early in the initial design and direct installation of equipment accordingly, the cooling system can become a variable quantity, adding the aircraft with sufficient weight for design and controls and operating at low efficiency.

Laboratory simulation is a valuable tool in analyzing and improving sub-systems, according to J. T. Cooke, chief of thermophysics, Convair F-75 Wichita. Cooke delivered a paper on sub-system design evaluation.

Sub-system requirements should be developed from overall weapon system requirements, making possible more intelligent and efficient work, and phases of sub-system evaluation, Cooke said.

This background knowledge is particularly valuable when the need for a cooperative analysis or in cases where the segmented is somewhat variable of their requires interpretation, he said.

Early Stages

Analytical evaluation of sub-system functional design in the early design stages permits usage of more complete software data and reflect software data, and can permit an interpretation when they can be made most economically and efficiently, Cooke said.

The Convair analyses staff pointed out that this evaluation is not a question of primary sub-system analysis but is an approach that takes full advantage of latest knowledge of the software and other sub-systems.

Last phase of evaluation is represented testing in the laboratory and in flight. Cooke said that for laboratory evaluation, the most fruitful laboratory

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... the T-37 Twin Jet Trainer with C.A.E. Turbine Power

Air Corps flight training routine took a significant step forward recently, when the T-37 twin jet trainer entered its Phase VII testing at Randolph Air Base, Georgia. Twenty hand-picked officers embarked on a course known as PROJECT PALM, with the two-way goal of training for them, and sustaining testing for the phase. This new high-performance ship advances the jet phase of flight training in an earlier stage in the training schedule, speeding the transition from propeller-driven planes to jets, with gains in both safety and economy. Twin J65-T-8 turbines by C.A.E. provide the power.



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ing closely with Pratt & Whitney Aircraft engineers, carried out the exacting engineering on such vital engine components as the compressor bleed governor, and the bleed

governor actuator. For single and dual-engine military aircraft, the Holley main fuel control is a component used in the Holley governor and actuator.



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tests are these: fuel/air, actuality of the airframe, but sometimes of other subsystems in the plane, malfunctions and other physical anomalies are brought to light and appear in a qualitative form.

Goode observed that the value of flight tests can be greatly enhanced if they are both preceded and followed by laboratory simulations work. Flight testing of a new engine system is a long undertaking covering many subtests and pieces of equipment other than the subsystem being evaluated; he pointed out and test conditions are sometimes difficult to control.

Many of these problems can be made worse as described in laboratory simulation, Goode said, with the result that a simulation setup is effective in reproducing troubles encountered in flight.

Thin Wings of CF-105 Influence Hydraulics

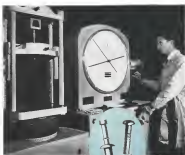
Detroit—Designers of the Aero CF-105 Aeronautics decided to use a 4,000 psi instead of the usual 2,800-3,000 psi hydraulic system because of limited space for electric actuators in the uppermost wing section's wing, 3-5 Wing of Aero told the annual Vulcan Hydraulic Conference here.

Each actuator had to meet a dynamic rating exceeding 50,000 lb. at 40 cpm/sec. electric movement and was required to fit chordwise into the restricted space bounded by the leading edges of the thin wing section.

An increase in 5,000 psi, was considered but was felt to be beyond the present state of hydraulic equipment. At it was, Aero had difficulties in finding equipment for the high pressure system. Wood and most of the equipment is now made, and is being ground checked before flight test of the CF-105. The 70 gpm. pumps used in jets to supply the aircraft's three hydraulic systems are currently being qualified at Vulcan. Through testing and test problems have been encountered, Wood said that the pump (Vulcan PV 9019) appears satisfactory.

Once the higher pressure was accepted, Aero found that it was easier to fit the actuator in the hydraulic system throughout the plane. For a simple transmission line could be one standard size smaller in diameter than a 3,000 psi system and it was easier to separate the pressure on the engine gear boxes. Because of the higher power available, it was easier to retrofit the leading gear within the four seconds allowed by the supersonic fighter's rapid acceleration.

These independent hydraulic systems are used on the CF-105 for the wingless actuator flight controls and the



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*Standard under MIL-A-8881, 2.11.6.0.1, 2.11.6.0.2, 2.11.6.0.3, 2.11.6.0.4 and 2.11.6.0.5

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Inc. Bedford, Ohio and Mechanics of Almond
Nichols Corporation/Engineering and Design of
Technical Facilities: Quinlan Inc., Austin,
Texas; Production: Corvair Shafter Ltd.,
Shafter, California and Almond.

Because of the CF405's size and speed, the flight controls are awkward for both no-discount pilot control and the added complications of attitude feel as well as stability augmentation due to speed had to be built in.

The mean area MHD 5006 index for RSGs spanning between -0.05 and 0.05 temperature bins.

Confronting Auri's decision to go to a 4,000 psi system, Control Cooker at the Martin Co. steel refineries, which showed that although a 6,000 psi system would offer advantages, especially that of space saving, he did not think that the amount of the gas provided raised the standard to 4,000 psi.

Times Sales Up 47%;
Research Trims Earnings

Tenneco Aircraft Corp. sales for the first nine months of 1994 totaled \$89,759,000, an increase of nearly 4% over the same period last year. No change, *sic*, don't a \$1,746,000 compared to \$1,127,000 in the first nine months of 1995. From attributes, due to more than doubled expenditures for research and development. In the first three quarters of this year, these totaled \$3,725,000 compared to \$1,610,000 in such work in the 1995 comparable period.

*Economic measures: the port has measures including some levies, which function as boosting sales and gross earnings, figures. Levies are attributed to stretches in McDonnell 131. Defense Navy, fighter component, production contracts and other measures.

P.1 Development Fighter Readied for First Flight

Test of the development birth of English Electric P1 fighters is expected to make its first flight soon. Probable of the P1A and P1B have been undergoing flight test for some time but under a scheme similar to USAF's Cobra II. The government has ordered 20 of the expensive fighters for development testing.

Rocket Engine Aircraft Reaches Record Height

London—Attack record of 7:10.8 set on Aug. 28 by an English Eke, the Cornish B7 has been confirmed in the International Amateurs Fed. circuit.

It is the first official world record—in an aircraft fitted with a rocket motor. The Canberra was powered by Napier double Scorpion rocket engines and two Rolls Royce A64 engines.



Armco 17-7 PH Stainless Steel

Unique properties of special Armco Stainless contribute to exceptional performance and economy of America's first propjet airliner

In the new Electra, Lockheed brings proper speeds to commercial aircraft. And combining its 7 mile-a-minute performance with the traditional streamlin safety and dependability of America's airframe demanded the best of aircraft materials.

That's why Lockheed engineers have specified Amco 13.5 PH Stainless Steel for many critical parts of the Elora. Where operating conditions are severe, the unusual combination of properties offered by this special Amco Stainless meets requirements most effectively.

The high strength-weight ratios of 177 PPH at room and elevated temperatures assure resistance to stress and heat, and its excellent lubricating characteristics simplify production.

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Broadly available in sheet, strip, plate, bar and wire, 22-7 Phb, when heat treated to Condition TH 1060, has a

typical room temperature tensile ultimate strength of 200,000 psi, 0.2% tensile yield strength of 180,000 psi and unusually high mechanical properties up to 500 F. On a strength weight basis it is one of the strongest structural materials available.

Equally important in both design and production, FFD PFR is easy to fabricate by standard methods. It is readily formed, drawn or welded in the annealed easy-to-work condition, then its mechanical properties are fully developed by a simple heat treatment.

Arcon 17-7 PH Stainless is used extensively in America's second commercial airplanes, military aircraft and missiles. Both 17-7 PH and Arcon's new ultra high strength stainless PH 15-7 Mo, offer you many possibilities to solve your design and production problems economically.

For complete information on the properties and fabrication of Armon 19-7 PH and PH 25-7 Mo Stainless Steel, write to us at the address below.

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Skydrol is the practical solution to concerns about danger from hydraulic fluid leaks. It is a fire-resistant, lubricating chemical, not an oil. Today, more than 700 airplanes in 40 of the world's major airlines are protected by Skydrol. They have logged over 8,000,000 flying hours . . . overwhelming proof that Skydrol gives protection.

operation. Tomorrow, when a TWA Convair 880 speeds from New York to Los Angeles just a step behind the sun, it will enjoy proved service from Skydrol 500.

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Russians Exhibit Coaxial Rotor Ka-15 Helicopter



Russian Ka-15 transporter helicopter pictured here is currently being displayed in Moscow. N. I. Kamov is designer of the aircraft. The counterrotating rotors are powered by one 215 hp engine. Maximum speed is reported to be 115 mph, and cruise speed is 75 mph. The two-passenger craft has a range of 11-6 h and a ceiling of 16,000 ft. Kamov stated two designs utilizing the dual coaxial rotor concept for Ka-15, which is now in production in a more advanced and complex version, and the larger Ka-26 which can carry four persons. Kamov has indicated that his next helicopter design will be powered by gas turbines (AVF Aug. 12, p. 10).



CL-41 JET TRAINER AIRCRAFT shows assembly of horizontal tail above vertical fin. Twin seats, on either side of fuselage, will load single parachute which will release at tail. Mockup from side presentation of canopy (right) to provide evaluation of cockpit vision.

Canair Stresses Versatility in Trainer

Canair, Ltd., Montreal is speeding development of its new side-by-side seating CL-41 jet trainer by building two prototypes scheduled for completion in fall of 1958.

Evidence of the project, in the wind tunnel and checkout stages, until recently, was first revealed in *Airweek* (Jan. 28, p. 11).

Initially designed to fill pressure through basic flight training missions, Canair CL-41 jet is also planned for additional roles. Company expects these future developments of the basic jet plane.

- Ground support role in addition to weapon training, will be possible through use of its universal port, now in preliminary design.
- Four-place configuration version "probably" will also be available in eventual development of the CL-41's extension. Such modification would make the airplane suitable for a variety of operations, including high-speed transport of important officials, also possibly as a light jet executive transport for businessmen.

CL-41 project marks the first airplane designed and built from scratch by the Canadian manufacturer, a subsidiary of General Dynamics. Hitherto its production has been concentrated in license-building of other manufacturer's airplanes, such as the North American T-28 series, Lockheed T-33, Douglas DC-4 and most recently extensively redesigned versions of the Bristol Beaufighter.

Indications are that Canair is seeking a work order for the CL-41 in both side-by-side seating but also U.S. Air Force and Navy. Also, the company notes that the airplane's open and recovery characteristics are designed to satisfy both U.S. and British criteria, which differ appreciably.

Recently, the CL-41 is a low-wing, tricycle landing gear configuration, its outstanding external feature being a 1 to 1 forward of the tail the airplane closely resembles the Canair T-17A jet trainer for USAF in external appearance.

A single parachute of the latest light weight design and low specific fuel consumption, developing approximately 7,000 lb thrust, will be ordered later.



100% BY-100% SEATING will be used to permit close coordination between instructor and student. Cockpit features will include pressurization and oxygen tests.

ing the General Electric J55 or Fairchild J55 are strong contenders.

Measuring 16 ft 6 in. long, 31 ft 3 in. high and 9 ft 6 in. wide, the CL-41 will have a wing area of 220 sq ft, a wing loading of 34.4 lb/sq. ft and power loading (based on 3.15 lb/lb thrust) designed gross weight of 6,739 lb.

Performance characteristics are first out in 1,000 ft, takeoff ground run, 1,700 ft ground idle roll on a 100-ft airfield. Stalling speed, at maximum weight, would be 63 kt; maximum speed at military power at maximum weight is planned at 400 kt and maximum speed at maximum power at maximum weight is 380 kt.

Fuel Load

Fuel load of approximately 2,000 lb will be provided, giving the airplane a two-hour flight turning circle at sea level without refueling. At altitude, with fuel reserve of 10%, the CL-41 would have a range of 600 nautical miles at an average speed of 300 kt.

Cockpit is planned to incorporate modern combat type equipment, including ejection seats, air-to-air weapons, other communications, two-seat pilot's instrument flight panels and head-up display.

General director of the project is W. K. Ebel, Canadian vice president-engineering, and E. B. Schaefer, E. B. Higgins is CL-41 project manager and F. C. Phillips is project engineer.



J75 Turbojet Passes Company Tests

New development model of Pratt & Whitney J75 turbojet engine met or exceeded all company performance estimates and guarantees during tests at the Naval Air Test Station, Dayton, N.J. Engine tested under all pertinent altitude and speed conditions in five steady engine to five 40 performance guaranteed water spray altitude conditions and the first to last, without any test guarantees, the company and engine is scheduled for Republic F105, Convair F106, Chance Vought F4U and Martin 201.

PRODUCTION BRIEFING

Magnolia Corp., Chicago, Ill., says it has perfected a 1-in.-wide square tube welded, welded, welded bond check, accomplished by first spraying on a special liquid and then applying infrared heat that causes tiny red particles in the liquid to be thoroughly transported by Brownian movement to positions over the joint joints in a few seconds a well defined hexagonal pattern coinciding with the hexagonal core uniformly in visible on the skin surface. This process works best on air turbine-welded metal once wet at all on non-headed non-aerostatic cores.

General Electric Co.'s Small Aircraft Engine Dept., Erie, Pa., says its J75 turbojet has successfully passed the 150 hr model test and has been officially accepted by the U.S. Navy. The J75 produced 1,065 hp, with 8.65 specific fuel consumption for the official test, bettering the original performance guarantee, GE said.

Contractors who have been using UKAI's Arnold Engineering Center's "Hot Shot" tunnel (ENR, Sept. 28, 1956, p. 67) are Bell Aircraft, Ramo-Woodbridge, General Electric Co. and Lockheed Aircraft Corp. Lockheed is using the tunnel for its Navy Polaris missile GE, Aero and Ramo-Woodbridge are subcontracts using the hypersonic tunnel for new ones in

Test Engineering at Marquardt



by
Roy E. Marquardt
President

Unique among air-breathing engines, the ramjet cannot run independently on the ground. Because ramjets depend on their velocity through surrounding air masses for compression of combustion air, ramjet test facilities must be provided.

Marquardt Jet Laboratory simulates these high-speed, high-altitude flight conditions during ground testing. A USAP facility, combined with special URN test facilities, MJL is one of the most extensive in existence today. Valued at \$18 million and occupying 8 acres of land, this dynamically functional engineering tool simulates the number of costly trial and error flights of new engines.

Complex test cells, with associated instrumentation and computers, permit sea-level and altitude testing of full size and test-scale models. In our two sea-level test cells, high pressure air is drawn over the test engine through hambone, sonic, and supersonic nozzles, and exhausted to the atmosphere. Turbines are ingeniously stilled in two full scale engine altitude test chambers to simulate heated and rammed air conditions encountered by high-flying supersonic ramjets.

Special configurations in both sea-level and altitude cells permit angle-of-attack of the free jet nozzles. This allows evaluation of the effects of varying angles of attack likely to be encountered by operational engines.

A new production acceptance test facility now being built in conjunction with our Opdon production plant will greatly supplement the up-to-the-minute equipment furnished the Marquardt Test Team.

With this facilities, engineering openings exist for:

Mechanical Engineers Aeronautical Engineers Electrical Engineers Construction Engineers

For information about these positions and the professional engineering environment at Marquardt, we invite you to write Jim Dale, Personnel Personnel, today.

Roy E. Marquardt



To Test Engineers Facing an ENGINEER | BARRIER *



Marquardt Means Opportunity—Test engineers no longer need feel galled by the lack of stimulating projects. At Marquardt Aircraft, the company where an aerospace engineer's has never ended, your work will span a broad range of superlative propulsion problems. Look to your future by looking to Marquardt, today. Address your inquiries to Jim Dale, Personnel Personnel, 16851 Sullay Street, Marquardt, Van Nuys, California.

Enlarged photo: Leigh Davis, Chief Engineer, Test Jet-Engine

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how specs have changed!

On December 23, 1967, the "Original American Avionics Catalog for Avionics" was issued. Specimens Number 8 states:

"It should be so designed as to stand in any country which may be encountered in field service. The starting device must be simple and transportable. It should also land in a field without damaging its structure."

That was a pretty tough problem in 1967. As planes took off and landed at higher speeds, the problems got tougher. Some of the answers have come from L.O.F. Example: Development of *Ethospace®* for windshields to give pilots perfect visibility despite triple threat conditions. *Ethospace* is in Canada's "CL-38", Lockheed's "C-130", Douglas' "C-123" and Boeing's "KC-135", among others.

If you have any question concerning the latest develop-

ments in aircraft glass, send it to Aircraft Division, Dept. 71117, Libbey Owens Ford Glass Company, 605 Madison Avenue, Toledo 3, Ohio.

In any event, write for a copy of *The Original American Avionics Catalog for Avionics* available for loaning.



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cater station for the USAF ICBMs. It is not known what Bell is using the facility for.

"Operation Houshoo," Africa Day, General Motors, got under way recently with a VC-154C equipped with Allison 101 D11 turboprop engines and Aero products 606 four blade propellers. The engine-propeller combination is the same that will be used on the Lockheed Electra commercial jetliner. Objective of "Operation Houshoo" and Africa, was to obtain 1,000 light hours in the shortest possible time under both military and commercial transport use. Africa, Allison hopes this to demonstrate the value of combining existing assets such as the Convair 440 to its capabilities.

Beryllium may be the answer to steel for higher performance, inside stress-free materials if it can be produced in useful quantities at commercial prices, according to Maj. Gen. William O. Scouter, USAF, procurement chief at the Material Command headquarters, Dayton, Ohio. Beryllium is six times stronger than steel on a strength to weight basis, weighs about a third as much as aluminum and will withstand 1,300°F temperatures, according to Sen. Ransom who beryllium is not now being used outside its high cost (\$300 per pound) against \$10 for titanium and \$2 for stainless steel and beryllium's time and advance costs.

Boeing Aircraft Co.'s Boeing model development engineers are using polyethylene plastic pellets about 1/32 inch in diameter to simulate effect of a super-sound missile flying into one stone. Depending on how much powder charge is used, the pellets' speed is from 2,200 to 4,500 mph. (Boeing Mach 3.6). Its line of travel is from the nozzle, through a sleeve through a small hole in a steel plate guard, through two pieces of paper used to simulate the pellets' velocity, and through an open oxide door into an oven where the target, a sample of the B-57's skin, is being heated to 100°F. Length of bullet is seven feet. Boring and the plastic readings do indicate on impact, leaving only a pink mark to show where they hit.

Stanford Research Institute, Menlo Park, Calif., has attempted to offset the adverse effects of nuclear radiation upon epoxy bonding adhesives by using during its "nuclear" activities and new thinner compositions. Beryllium, which is being tested as well as USAF funds has shown that radiation damage to epoxy resin takes two forms: cross-linking to form superhardened areas and cleavage or rupturing of desirable bonds of the polymer.

FASTENER PROBLEM



Miniature right-angle stop nut for cover hold-down saves space and weight on avionic unit

This is United Control Corporation's advanced Master Working System Control-designed and developed to reveal any aircraft system malfunctions. It is used in the supersonic Douglas F-105 Thunderbolt and has all key avionic components that represent most brightness, compact and highly degradable.

THE PROBLEM: How to attach a dust cover securely, with provision for easy removal for inspection and a high degree of fastener reliability. Yet this fastener job had to be done within minimum weight and space allowances.

THE SOLUTION: A miniature right-angle bracket net-Type A27M—especially developed for blind mounting applications, with a high-tensile nylon locking insert, provided the answer. A built-in "float" permits the nut to be self-sealing-to compensate for a dimensional amount of misalignment between nut and insert. If high temperatures had been a problem, ESNA could have supplied Type LSA27M which has the same features in Type A27M plus an ultra-rigid type of locking device which withstands heat up to 500°F.

YOUR FASTENER PROBLEM can be solved or explained efficiently at this right-angle bracket and application. So why not send this coupon today?



ESNA's line of right-angle bracket net-Type A27M is used in aircraft to hold down the dust cover net-Type A27M for applications where space is at a premium, the only true A27M nut for high tensile pressure nut (A27M).

MAIL COUPON FOR DESIGN INFORMATION

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Please send me the following fastener information:

☐ One sheet on Type A27M and Type LSA27M ☐ I require a drawing of my product. What fastening device do you suggest?

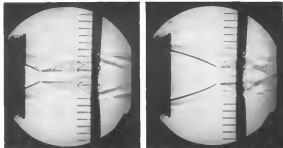
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MISSILE ENGINEERING



SCHLITMAN photos show expanded air exhaust from model engine head chamber in various flow at altitude. Approximate sea level pressure (left) with supersonic exhaust at right core. Photo (right) represents 20,000 ft. where center cone begins swirling.

Rocketdyne Develops Missile Engines Now,

By Richard Sweezy

Canoga Park, Calif.—Demand to play a key role in ballistic missile today and space vehicles tomorrow, high energy propulsion systems are being advanced through research and test at the extensive facilities of North American Aviation's Rocketdyne Division here.

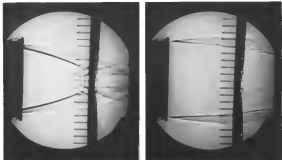
While large liquid propellant rocket engines for Atlas, Thor (see cover) and Jupiter are being thoroughly refined, as experience is gained in preliminary design, manufacturing and test techniques other schemes for a wide variety of applications are being conceived, analyzed, evaluated on paper and then tried, in some cases, in hardware.

Rocketdyne's preoccupation in the large liquid propellant field stems from a North American corporate decision in 1945 that missiles were to be important in future defense plans and therefore the company should immediately establish itself in the field.

One of several companies awarded a study and research contract on a missile system, North American established 15-man engineering group in



VACUUM wind tunnel, where the other photos on the page were made, is operated by Rocketdyne to test model engine components. Technicians Glenn Rowley and Arthur Smith are fitting part to test equipment. Rocket engine bottoms inside at right is waiting its performance trials. Row, pressure inside is a preliminary design and in which various nozzle shapes are investigated for exhaust pattern velocity.



LOW photos at 30,000 ft. (left) and 50,000 ft. (right) show distinct expansion. At right, white, clock-work air forming, somewhat evident. Thrust pressure in last photo is at same vacuum of space and gases have expanded beyond optimum point (below).

Studies Space

three major areas of supersonic jet-dynamics: thrust guidance and large liquid rockets, needed study the original engineering and guidance and directed all available data on German rocket work, proceeded from there into specialization according to interest. This resulted in formation of:

- Rocketdyne, for propulsive systems
- Autonetics, for guidance, electronics systems
- Missile Development Division, (MDD) for overall missile system
- Atomic International, which got a start in early work involving feasibility of nuclear power for an advanced weapon system. Study showed this particular application undesirable, but in the course of investigation, a competent staff and bank of knowledge were assembled and the group stayed active, went into commercial reaction work.

Under present organization, division operates as entities according to their specialties. Typically, if Missile Development Division conceives a missile system, Rocketdyne bids against all comers for the propulsive system. Autonetics likewise takes open competition for guidance and electronics contract. By same token, division are free to bid on contracts with other principal weapon system contractors.

Division philosophy, structure and





Surviving Impact is an Eimac Ceramic Tube Extra

Aerospace electronics demands extras from vacuum tubes. Among them is the ability to withstand heavy impact without losing electrical characteristics. The photograph dramatically shows what happens to a 250 watt glass envelope tube and an Eimac 300 watt ceramic tube when both are dropped from a height of seven feet. The ceramic tube "took it."

Other advantages of Eimac ceramic tubes are resistance to damage by vibration and temperature (under 350 without sacrificing power), ability to undergo optimum processing techniques that lead to high reliability and longevity.

For further information, consult our Application Engineering Department.

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SAN BRUNO, CALIFORNIA

Eimac Tubes with Ceramic Tubes that can take it

The small Eimac ceramic 4C3000A, shown above, will withstand 50G shocks of 10 millisecond duration. It will operate in airplanes or ground station service at full ratings up to 500mc.

In its new line of ceramic tubes, Eimac has the answer for the aerospace engineer who needs a tube that will deliver full output under extreme environment.



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	PR	AM	SSB		PR	AM	SSB
B+C Plate Voltage	3500	1500	2000	Plate Dissipation watts	300	300	300
B+E Screen Voltage	350	300	450	Screen Dissipation watts	17	17	17
D+E Grid Voltage	-250	-250	—	Grid Dissipation watts	2	2	2
B+C Plate Current	250	200	250				

management policy. Rodenhue off with believe in the key to the aerospace's present leadership in long-lived rocket engines which are used in USAF, Army and Navy projects. Rodenhue achieved full division status in 1945, but had been developing sound data in management and other necessary techniques during preceding 18 months.

Division's Freedom

Division management gets policy guidance from corporate officials, is autonomous in day to day operations. Profit and loss are up to division management. Division has capital funds at its disposal sufficient for several years.

Internally, Rodenhue is organized functionally. Basic units are design, tubing, plate section, engineering and manufacturing. In line with present and becoming standard, quality control is a line function rather than a part of one other group.

Engineering is broken down into preliminary design, design and development, test operations, research and administration.

Research, under Director John Finney, is planned and directed rather than basic, is aimed toward application in general, not those specific. Operating, according to Tammes, "are step behind true basic research, the section takes advantage of work basic research centers in terms of brand tube, tube quality, all these things are being closely followed today, are basic work is continuous and free radical's Rocketdyne brand tube. Finney says, is gathering much information from observation, line tests, up, physics get to correct an situation at the surface, now is finally established as integral part of research work.

Much of section's efforts are devoted toward observation, test results, performance. The researchers have a hydrocarbon laboratory equal to or better than those maintained by most all industries.

Newer Tubes

While work in hydrocarbon fuels currently receives greatest attention, new area are not neglected. Research section currently has started to follow the free radical path looking toward the next generation of rocket engine fuels.

Work is being accomplished in heat transfer associated with operation in ramjet type engines, as well as in heat and pressure, fields of dissociation.

A problem for researchers Tammes points out, is the facilities and equipment necessary for observation class research. Since rocket engine work is comparatively new, Rocketdyne research frequency has to design equipment and facilities aimed at its own



Lockheed's P-104A Starfighter

Reaching for the Stars

With its new air-cannon design, high T-shaped tail and knife blade wings (just 21 feet, 11 inches from wingtip to wingtip), Lockheed's P-104A Starfighter is America's fastest fighter—11 times as fast and so fast that pilots almost feel they are running out of sky room.

The Starfighter performs near the fringe of today's understanding of aerodynamics, and incorporates in its design unusual features suggested by the most recent developments in the field. Because of its advanced design, many new questions arose—questions which were answered through extensive wind tunnel testing.

CWT—the Southern California Cooperative Wind Tunnel—played a vital part in this testing. Throughout its development, many hours were spent by CWT's staff in gathering data on the P-104A's aerodynamic behavior. The success of this work is reflected in the Starfighter's performance record.

The CWT is responsible for testing many of the nation's most important aircraft and missiles. In addition is its five owner companies, CWT also serves other leading aircraft firms and government agencies.

If you would like more information regarding the CWT's facilities, or information regarding employment, please write us:

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Ability to hit a distant target is the real measure of a missile's effectiveness.

That and the ability to carry either nuclear or thermobaric weapons are characteristic of both Northrop's Snark and Chance Vought's Regulus II, for the USAF and the Navy respectively. To accomplish their vital military mission, all components must function perfectly during long-range cruising. A stable, reliable electrical system is mandatory for guidance and other electrically powered functions. Sundstrand Constant Speed Drives provide compact and lightweight generator propulsion with both the capacity and stability necessary for optimum performance. They are two more in a constantly growing list of applications with outstanding records for reliability and performance that keep Sundstrand first in constant speed drives.

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"Snark"-Type Sundstrand Drive unit in the Snark's engine compartment on its output shaft while a "Regulus"-Type unit powers the generator in the Regulus. More than 30 custom-engineered models of Sundstrand Drives have been installed in virtually every type of naval aircraft as well as in many other applications.

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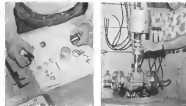
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CONSTANT SPEED DRIVES • AIRCRAFT ACCESSORIES



VALVES for liquid engine rocket motors are checked out at Rocketburn's Santa Sotara Equipment Laboratory before motor is fired. Mechanics (above) are running a check.



CARE with which components are handled is illustrated by mechanic's rubber gloves (left). Valve is being set in test bed before checking (right).

preference requirements, requiring a need for "talent on talent." That is, having people skilled enough in their own fields to be able to design equipment for new or unfamiliar work while simultaneously having personnel enough to accomplish critical work.

New radar construction at the Pasadena Field Laboratory at Santa Sotara, about 10 mi. from present offices, is a half million dollar research building.

Once radar problem contributed in Rocketburn's research according to Torrey, it is the mathematical abilities of those joining the service. Presenting the difficulty is the schools which still teach the same mathematics for engineering and sciences courses straight years ago. An increasing problem, used first because from his school mathematics class to the higher level in current technical use.

As example, Torrey says, is that of probability theory which was less an integral part of mathematics and more

basic as to require extensive tests and laboratory investigation. Due to financial considerations, this theory has to replace experience in rocket engines to an extent that decisions engineers must have faith in it and use it even though they are unfamiliar with the theory.

Concerning money for research, Torrey declares there is no dearth at all of financial support for a worthy project. Ideas for research work must have merit and for those, there are ample funds. However, one catch is that to sell the ideas, researchers themselves seem to need the answers in order to tell management of the problem. Much of research projects come from suggestions to the military, Torrey says, but sometimes the military approaches the company to tackle a particular task.

When a research field looks promising, according to Torrey, yet is not far enough along to be made into a firm proposal for research project contract to a service, company, funds are available in being the work to the stage

when it can be shipped into a test pool. Once again, he points out possibilities here to be fairly well founded before much effort will be approved. Finally, indicated that Rocketburn has conducted extensive study with solid propellant rocket engines, but he favors two factor details, starting with liquid propellant for long engines, the inherent flexibility of liquid propellant engines and a narrowing of the complexity gap in solid fuels for higher thrust levels and inherent flexibility to make them operationally worthwhile.

Preliminary Design

Scope of Preliminary Design under George Sutter, a vice president, includes:

- Conceptual product studies
- Preparation system studies, determining whether rocket propulsion is best for a particular application. Rocketburn's standing in the field is such that customers frequently consult Preliminary Design people when formulating requirements for a particular application.
- Preparation of proposals for designs.
- Technical studies of needs, considering the Canadian requirements. Current technology as available in service or given existing technology, is one application of this work.
- Newsmade applications such as sea Navy aircraft launchers (AW No. 18 p. 27).
- Advanced studies such as those existing in the Strategic Space vehicle with no propellant currently behind the next logical first step in space tailored propulsion systems (AW April 4, p. 27).

An area where preliminary design leads a heavy work load is in propulsion system studies with respect to the integration between engines and guidance systems.

Alternate Approaches

Two conditions defining different approaches and degree of implementation in preliminary design estimates are whether a missile is required to reproduce a trajectory, follow the same general path, or whether it has a strong trajectory control staff. First condition requires well defined in thrust, weight, velocity and range to fulfill its mission.

Considering those, parts of propulsion systems which facilitate guidance are less significant than other systems require detailed analysis covering all aspects of operation. Typical is the large kinetic energy and adjusting thrust which are the basis of a guided rocket engine.

One development the section produced in its work is a double ended rocket motor for measurement of thrust



A new dimension of sea safety



The Canadair CL-28 is the most formidable search, strike and full maritime patrol weapon in the air today. It is quantity production for the Royal Canadian Air Force and is available for purchase.

The CL-28—a direct derivative of the Bristol Britannia—carries the most comprehensive collection of electronic and other detection equipment ever assembled into one aircraft for locating, tracking and "finishing" enemy submarines—whether submerged, "surfing", or on the surface. Once contact is made, torpedoes, depth bombs and other offensive weapons are released.

It was specifically designed for long periods of ocean patrol duty... tactical coordination with naval surface craft on defensive and offensive maneuvers... convey and receive—remote operations.

The CL-28 will meet or surpass the requirements of friendly countries responsible for the defense of coastlines and sea approaches. For full information, write directly to vice-president/sales.



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507070

used at each area. Propellant liquid (Lubrication) is a liquid oxygen plant, tracks the motion from plant to each stage, then goes to flow storage to test tanks in rapid. Fuel travel in from center stages is handled separately so that tanks depend if it area storage tanks, and it is piped to stage at needed.

Hydrogen is stored at several strategic locations from which it can be piped to more than one test stand area.

Opportunity Boats

Although general test programs are outlined by an advance planning group before the start of a test campaign, an opportunity arises to some extent. Since a run may be scheduled on one stand or on two only to have a flow delay firing for a test, it another stand in the same area is closed, it is firing, it will go ahead. The earlier scheduled stand will wait, rather than tie up the entire area while problems are solved. Since runs must be checked off all but control control personnel time is lost for mechanics and technicians who are not back to a runbook that is formed when a firing is done. To use the time, runbook schools are being formed to upgrade general knowledge of activities in the fields related to their work.

Safety programs give constant plug plug. Workers are kept fully aware of hazards accompanying materials they work with, nothing is so excellent in safety record despite nature of the work.

To obtain maximum data without test work, actual exhaust have been utilized in a number of studies. One run on a flight of exhaust is made, and the meter runs which which have been put through exhaust at some point in flight time, attention was fixed, but less

than had been anticipated. A second investigation was on more complex.

Rocketdyne test people have had to design much of their own specialized equipment, such as the 50-ton flame deflector and the exhaust water separator system which protects them during an engine run. They have adapted stores not usually associated with flight in use place to their own purpose. One is a 1,500 ft. x 6 ft. structure directly used as a water tank (built in 1911). The same run who run it for the first time has reported it for Rocketdyne. General purpose test, 1,500 ft. World War II submerged submarine. Construction done in peacetime techniques at operational speed without resorting to gas power for each test.

Another special test developed by Rocketdyne is a combustion-stability monitor. Incorporation down of the test engine is used, it is to cut off at engine after seeing malfunction, avoiding it and activating cutoff before. Often, before a malfunction was visible, flame deflection was noticed. Combustion stability monitors usually observe over 100 test periods, 20 milliseconds and if the number is out of preset bounds it automatically cuts the engine. It is automatic in observation on oxygen pressure to combustion stability.

Taking further precautions during each run, a number of mechanics with engine control monitors are present at perimeters of test plants, and should learn be needed or avoided, cutoff is the rule. Construction is the first to protect equipment engines, stands, facilities and equipment. Of the 1,500 test people, as test space time, 90% test, in instrumentation, the largest problem area of the testing operation. Majority of attention is

used by modern test instrumentation, but a number of people are engaged in instrumentation research.

A basic need for modern work is to decrease accuracy performance of individual systems in test data on their mechanical characteristics will accompany the engine into service and permit accurate flight programming in operational tests.

In motor test instrumentation, temperature is the key factor in the current headache in liquid hydrogen work, measurement to 0.1 deg. accuracy is required but better accuracy is desired.

Test instrumentation people would like to measure high and low temperature gradients to a 2 deg. over a 90 deg. gradient. Since they do not have the equipment for real reliability and response temperature, it is a problem to get readings in a steady state.

High temperature areas fall in gas generators and turbochargers, turbine inlet temperatures as well as thrust chambers. While generation and propellant are required to operate under these conditions, they have much higher temperatures as hydrogens flowing into the propellant chamber in the case for higher specific impulses. Currently, a full scale program has been initiated to determine what instrumentation method will be used in these over 2,000 engines. A literature search is under way, a work sheet made at the time of analysis.

Temperature Problem

Mass flow, where temperature gives a part, is a severe problem. Accuracies less than 1% of the 15,000 lb. test, and even greater accuracy is required. Temperature transients are the largest, and while droopings respond up to 10,000 cps, it is obtained, accuracy of magnitude of constants in the work point.

Volume flow, including tank needs, are under good control with tanks, flowmeters, to 0.2%.

Are instrumented pressure variations, numerical ones are trouble spots in obtaining high frequency data such as accelerations and pressures near the engine while it runs, since such test sets more than 1,000 ft. Combustion chambers, acoustically isolated are used. Instrumentation has less and error rates are major problems, with 10 cps experience to date on. However, and fluctuating data, to a sufficient precision of conditions will occur.

Raising test instrumentation is now being centered about the Instrument Test Digital On-Line Transducer, is currently a high speed analog to digital converter which takes data from test stand sensors, processes it for IBM 704 computer on tape, to provide more



ROCKETDYNE developed engine for Army's Redstone missile. Here shown in first stage of Jupiter C test vehicle being fired at Cape Canaveral Fla. Test cost, assembly, service is only, Department of Defense claim. Being test used long.

guided test faster than it previously is available. Plans call for use of these computers to be operating by next few weeks at least one per control stand. Since the computer is at Georgia Park, the original intention was to move some data back to Georgia Park so that engineers could be looking at computer data while a run was in progress. Presently, tapes are taken to Georgia after run, and some difficulties have been encountered with the instrumentation digital on-line transducer.

Engineers in control room must also have the transducer readout samples available to him in addition to current test instrumentation now in use. New component test lab under construction is designed around the instrument digital on-line transducer and will have backup of some standard types.

Most instrumentation as test stands consists of commercial items in many cases, they were originally developed around rocket engine requirements, a large variety around Rocketdyne's up photores, and have become standard items.

In addition to a combustion stability

monitor, an outstanding Rocketdyne development is in a sophisticated and available indicator will give accurate measurement of one and another in tanks of unique facts and conditions. Signal output has been put in digital form, but the predominant output is analog.

Reliability Check

Statistical analysis of measurement performance is used to obtain reliable indication on data. Analysis is continuous, based on new calibration information which is constantly fed in as new data is integrated, and older data is dropped. Small sample size technique is used and a maximum plot made. Instrumentation people can evaluate test engines that data, based on recent calibration runs and statistical analysis, will have a certain headwidth of data. System series to check reliability of measurements, as well as setting a guide for upgrading accuracy.

Most critical measurements are now obtained to $\pm 1\%$, but the desired figure is $\pm 0.5\%$. A goal is third measurement to $\pm 0.1\%$ at a 95% confidence level.

and standard procedure is to adjust the accuracy to maintain the confidence level.

Current standard is 14% accuracy in an engine of all previous measurements, and basic, low critical pressure measurement accuracy is allowed to decrease while effort is directed at improving accuracy of most critical measurements.

Instrumentation growth needs, according to John V. Edwards, instrumentation research chief, a new and current set of standards. His points are the rethinking of thrust measurement with a device, compared with thrust measurement on a test stand and final thrust, that of engine in flight under major viewing circumstances.

Current status has a dynamic condition on a static standard, he says, and while new aerothermodynamic theory is becoming available to determine thrust and other parameters on a test stand, there are no instruments to check the theory in other standards of measure in the new era.

Needed is development of new instrumentation designed especially for the new era, and work is under way at

Rocketdyne: Key Personnel, Facilities

General manager of Rocketdyne is Samuel Hoffman, long time rocket engineer and William G. is assistant general manager. Gen. pres. Fred Wilson also serving Wright Field following World War II.

Chief engineer is T. F. Brown, assisted chief engineer in Fuel Dept. Under this section are: Preliminary Design Group; Service Design and Development, W. J. Bernam; Test Operations; William G. Kersbach, John T. Tamm.

Manufacturing is headed by Earl Clark. Quality control by Robert Harty, Service by James Broadhead.

J. F. McNamee heads the Number plant where 400 are employed, building engines for Atlas and Thor at 225,000 sq ft at plant. A 2nd area of Rocketdyne, Cape Park, some 100,000 sq ft. There also is a 100,000 sq ft. engineering building—on 64,000 sq ft. installed building. Other divisions include 900,000 sq ft. overall.

Employment some about 10,000—1,000 in engineering, 4,000 in manufacturing, plus 500 in service, and needed activities. Of the 2,500 employed at Propulsion Field Laboratory, 1,500 are in engineering, 1,000 are in technical, mechanics or in service.

The division employs about 2,000 graduate engineers and scientists.

Barclay to developing instruments which will enable scientists to understand the phenomenon under the development of instruments as end products.

Researchers Wilburson and his colleagues select engines which, with adaptation of the NACA developed spray-gage geometry which gives a direct measurement of backdrafts in a jet engine. This has made laboratory studies of flame with varying cross sections of temperature coefficients, calculating what these would mean in an engine on a test stand firing. Work is progressing in study of rocket exhausts at the stable and semi-stable spectra.

Ultimate aim of the center of basic research projects is development of an instrumentation which can analyze the engine exhaust and fuel mixture direct measurement as a constant standard base for the exhaust is in motion, the flow rate, current, engine thrust is absorbed by high altitude space gas type load cells which are shell stress.

Exhaust Data

Then data as far as yielding much knowledge in the nature of rocket exhausts, on the basis of spectroscopic work, that have been collected in the long-term research work now being made.

Working in test programs specifically designed to provide data that, used in research work, during more sophisticated analysis of data growth acquired in research field is known distributed current in measurements in that certain development of engines can be specified. Their work has included fuel analysis of engines, and small laboratory test data proper method selected the preliminary design.

Under way is an intense effort to find out what rocket engine combustion is available, and what part is component is responsible.

They are working toward better understanding of the direct load sensor range scale, since by understanding the slope they will be able to control it. A goal is automatic control of an engine to flight to produce required thrust accuracy.

Over the years, significant gains have been made in pressure measurements. Biggest single step is the current method of measuring pressure at the throat chamber wall which entails using small, expensive equipment operating in contact with gases which are at more than 3,000°.

Researchers are able to make these measurements without distortion in the aerodynamic shape or phase is available the way shape of the rocket, between the top and bottom and sensing device at the chamber wall. This way, they need not worry about

New Martin Division

Martin Co. has created a new division to coordinate all testing arrangements for launching of the Navy Vanguard rocket satellite and the Air Force Titan intercontinental ballistic missile.

G. T. Wilcox, the company's corporate vice president, said that the division will be an additional device in the present and ground mission of the new division according to George M. Bender, Martin Co. president.

Division, which has not yet been named, will have equal status with Martin's Baltimore Division and Orlando Division. Wilcox will direct all Martin activities in the Patrick Air and Cape Canaveral area including command being of the most recent units of the USMC Vindicator missile.

According to Bender, the fact that the same year produced new tests change of our selection at Patrick is a measure of the company's dedication to do its job, and the fact that it is the most possible work.

deformation from radiating pressure near amounts at a distance from the test area which is not being done.

While the instruments do not give a highly accurate direct reading, enough is known about the instruments that accurate correction can be applied.

Adding mechanical and electronic devices to the instruments themselves, they have developed a proprietary system known as DMPF which compares the inherent mechanical and electrical distortions present in sensors.

Minimization of rocket engine is accomplished 90% with standard, no change tools, the majority of specialized equipment being used in inspection.

One major special step to meet the engine field testing criteria, part now being necessary in its operation. Changing technology limits spectra shape to a new state-of-the-art.

Persons need reliable testing, stretch space and hydrogen bonding, welding, brazing and brazing.

Forging and Forming

These chambers and nozzles are forgings, machined to final dimension. Gas generators and turbochargers involved formed engine sections, machine metal rotating parts. Blackstone has designed special machines for its forging and stretch part forming work.

are involved in hydroforming. However, these are the most difficult production parts, due to their elongating changes and the closer tolerances involved.

In its forming process, a machined part is being on the length stage of a part from a part which has been deformed. However, machine parts are being made in a machine, a step order, which specifies part how far the section goes in its particular operation, regardless of the steps called for on the print. Remanufacture of the work is left to be accomplished at a specified assembly point.

Assembly Technique

"Packaging" technique is used in building of thrust chambers, injection pumps, small rocket engines. Technology has rough machinery accomplished on parts, then assembly work which welding is involved in rocket or gas laboratories, using liquid, oxygen, fuel, air, gas and some systems, and most welding is accomplished in each stage, after each rough machining.

When parts arrive at the final assembly stage for each component, roughly 80% of the work is done, remainder being in final machining.

All components except burner engine parts are fabricated at Blackstone, rather than Camp Park. As part of the Camp Park facility, both building of engines is accomplished on station type production line from finished components.

One, being used to be done. Development facilities are in laboratory in the conventional manner.

Due to the unique work involved in the machine engineering, Blackstone's facilities, it is a long-term commitment and from there to the division's production requirements a process demand since they retaining experienced men.

Manufacturing is equipped with a hydrostatic test facility and engines are run through part to testing to State Service for final firing test. Engines are run through hydrostatic facility in other areas from Population Field Laboratory test.

Manufacturing leaders feel that the current status is optimal, yet retains the flexibility they require.

Quality control at Blackstone is accomplished by inspectors, with statistical methods.

According to quality control staff Robert Heath, the sections business is quality in activity, a control.

For its work, this section has a production development laboratory, for special investigations. Results of its investigations are fed back to the proper department in the area.

Activity also includes running quality control, which is a continuous process. The evaluative staff does a regular qualification, plus annual functional

tests, then a breakdown of the engine and inspection for general quality and workmanship.

Quality control tests hardware to the stage, where it meets the standard. The part works at all times it is supposed to. "It is intended to be sufficient to eliminate random failures and yield some high confidence level."

One of the biggest problems has been in testing components that make parts for statistical use in rocket engine production. The standard of base-leaving and cleanliness necessary for this work. This tolerance and high statistical speeds make it difficult to meet more control of a production.

However, that research, important operating section within Blackstone is the service division, headed by James Blackstone, in scope of which is:

- Field service, launch, overhaul, of support in field for industrial sector.
- Service management for products.
- Logistic support units for customers, which functions under contract costs, as customer representative with inside track to factors.

Compared their schedule of company development has covered varied research and development capacity to enter the field as operational units. Service has to keep their working.

While the unique nature concept will be an overall mission, rocket engine technology indicates that no one person or group can leave all their thinking, that entire manufacturing will be less informed to their own projects for support in the present contract. Blackstone has, over its 10 years experience in testing engines, built

up a good line of knowledge, service requirements as its philosophy.

One of the problems facing service was to select engines in testing, the customer's management provided to think in solid engine tests in plan, as well as testing the parts and both technicians on the firing parts.

Under the new concept of logistic support for missiles (AWG Aug. 25, 1961), contractors act in the area formerly occupied by Air Materiel Area. Under the concept, contractors act as management for their logistics in area, and Blackstone has to hold the logistic support overhead for all its regions.

To get and hold these contracts, the service has to overcome management skill to a high order, be able to:

- Coordinate engineering documents and technical into all efforts on ground at mission end in three, more.
- Realize and plan accurately for actual and type of space parts necessary to support particular program throughout its life.
- See, when progress is slowing to a stop, that some steps are needed back in better production line, ensure financial loss in absolute space parts.

Rapid Servicing

Working with engineering to ensure a high degree of interchangeability in all parts, and to keep a master part specification or its comparison of all of them, Blackstone feels they can really speed up repairs through the use, in process. They will be able to determine from the customer what model

they are a ready hand, and what model he desires to have is modified to Parts to accomplish the change to the new specification can be made while the engine is in hand. One of the serious difficulties, which is to have two or three quarters not far from the factory, the engine will be disassembled; these have parts according work will be provided, the engine can be assembled to the new model specifications inspected and sent on its way, as a new time. Old parts are referred to the factors for reuse, or scrap.

USAF is investigating, at its Miss Texas, Calif., facility, system to gather data on all before, under, or under engine. Information compiled will be for reference, will serve as basis for a central information agency on rocket engine problems. Blackstone since is contributing all its experience to aid the USAF's completion, the goal of which is regarding all U.S. missiles.

Anti-Missile Function Consolidated by Army

Headquarters, Ala.—Separate unit to ensure antirocket work has been established at the Redstone Arsenal, the Redstone Arsenal of Army Materiel Systems Office, will be headed by Col. Marjorie R. Collins who will this summer as his present position in the nature of the research and development division enhance missile laboratories.

Anti-missile office will incorporate an older group of the anti-missile missile branch of Project Management Staff of the Army Ballistic Missile Agency.



Swedish Saab-32 Lansen With Air-to-Surface Missiles
Sub 32 Lansen, Royal Swedish Air Force all-weather attack plane is armed with Swedish-developed air-to-surface guided missiles along with Type 304. The 304, powered by a rocket motor, can be fired outside the range of air-to-air missiles but can be controlled visually according to Saab. It can be used against land or sea targets. Sweden has another guided missile, Type 305, which is a more versatile weapon, made by the firm from destroyer type vessels against other vessels. The 305 has two propulsion systems for tactical coordination it has been built in smaller numbers, but retaining a speed type of jet engine. Guidance programs might include:



ANCC electronic warfare battle of wits between man armed with electronic countermeasures, in flight at installations such as one shown above and at right, operated by Rohrbaugh, Inc., in Florida for Air Force, and a large one located near Rome Air Development Center

Exclusive Report on Countermeasures: Part II

Avionic War Aims at Deceit, Confusion

By Philip J. Klass

New York—"Any ride in radio electronic warfare is not a pleasant given sufficient time and effort," one of the Air Force's top electronic countermeasures specialists declares.

The major air battle is fought by electronic warfare systems (radio, radar or infrared) in potentially vulnerable to enemy countermeasures and this is why a major portion of the U. S. war effort is being shifted to electronic warfare. The battle is not fought by electronic warfare systems (radio, radar or infrared) in potentially vulnerable to enemy countermeasures and this is why a major portion of the U. S. war effort is being shifted to electronic warfare.

The term "jamming" is sometimes applied loosely to all types of electronic countermeasures, including both active and passive types. Usually the term is applied only to active types of electronic countermeasures.

Battle of Wits

It is common practice to speak of jamming as a direct radio or radar or infrared warfare system. It is a battle of wits between man armed with electronic countermeasures and electronic countermeasures, and between the operators behind the lines who develop this equipment.

For example, a B-57 crew finds its jamming under radar surveillance by an

attacking interceptor if it does not allow time in its electronic countermeasures equipment. To do so might jeopardize the bomber's location for the intercepting battle; thus the latter's radar. The electronic countermeasures operator must analyze the tactical situation before deciding whether to use or maintain electronic countermeasures release.

Even when electronic countermeasures are used against a radio or radar, the battle is not fought by electronic warfare systems (radio, radar or infrared) in potentially vulnerable to enemy countermeasures and this is why a major portion of the U. S. war effort is being shifted to electronic warfare.

What is Jamming?

In the strict sense of the word, jamming is the most elementary form of active electronic countermeasures—the transmission of electromagnetic radiation, usually at the same frequency as that on which the radio or radar is operating. The electronic countermeasures transmission seeks to overpower the radio/radar signal or to confuse and confuse the operator. This battle from approach has the advantage of requiring only comparatively simple equipment. It has the greatest disadvantage of disclosing to the enemy that he is being jammed.

More advanced and sophisticated types of active electronic countermeasures seek to deceive and/or confuse the enemy without disclosing to the fact that electronic countermeasures are being employed against him.

Active electronic countermeasures are used with attempts to use radio countermeasures. These techniques were adopted and used later against radio than it appeared on the military horizon. Some of the jamming techniques used against radio countermeasures are:

- **Spurk jamming**—one of the simplest and earliest techniques. It employs a quick, gap to produce short duration jagged pulses of noise. The effect is to scramble the noise generated by some electronic means in home broadcast receiver. Spurk jamming is relatively easy to produce in low frequencies.

- **Wide noise**—a more sophisticated version of spurk jamming which can be employed at any frequency. The random noise produced by gas discharge tubes for example, can be used to saturate the electronic countermeasures transmitter's output. Noise or spurk jamming generally is considered a brute force technique because it requires considerable transmitter power, radiated over a wide band width (portion of the spectrum) to be continuously effective.

- **Frequency hopping**—a radio actively capable of changing from one frequency to another in a sequence of different radio tones repeated over and over. It sometimes is called "hopping" because it produces a sound like the tail of the instrument. Although the radio sequence, continuously repeated, does not completely blind out the receiving signal, it can be extremely disturbing to a radio operator.
- **Electronic jamming**—a based on the principle that in electronic countermeasures transmitter operating on a carrier frequency which differs slightly (1000 cycles or less) from the radio transmitter frequency will produce a continuous beat note (tone) in the receiver's output. This is the familiar high pitched signal heard in home receivers when they are out of adjustment. If the carrier frequency of the countermeasures transmitter is closely swept back and forth across the radio's frequency, the resulting beat note on the radio operator's ear resembles the proverbial wind of a broom.



radio and the human ear to receive less such of these pulses, the effect is equivalent to continuous jamming. However, the technique has the advantage that available energy is concentrated in a relatively narrow band width, reducing transmitter power required. A single portion of the type also can be employed against many different receivers operating at different frequencies.

- **Stepped tone jamming** consists of a sequence of different radio tones repeated over and over. It sometimes is called "hopping" because it produces a sound like the tail of the instrument. Although the radio sequence, continuously repeated, does not completely blind out the receiving signal, it can be extremely disturbing to a radio operator.

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Intelligence purposes. Recently, however, the Air Force has developed "continuous look through" techniques which make it possible to receive and transmit simultaneously on the same frequency. This opens the way to receiving an enemy transmission while simultaneously jamming the radio receiver at the other terminal.

A more subtle loss of electronic countermeasures can be employed to deceive and disrupt the enemy without his knowledge. This is the use of radio broadcasts, in the enemy's native language, intended to lead him into thinking they are coming from his own headquarters. Such deceptive countermeasures are far more difficult to bring off successfully, but offer greater tactical pay off.

During World War II, for example, the British operated radio transmitters which were accused by German language operators. These operators would get false general combat intercept instructions to German fighters.

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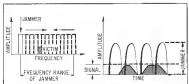
ANALOG HQ jamming radio frequency spread spectrum jamming employed of low frequency (upper) and medium (white) wave modulation visible at any frequency (lower).

seeking to locate attacking bombers. Not infrequently the German and British radio operators would give countermeasures instructions and engage in heated arguments as to which was the authentic station, while German pilots rolled around the sky completely befuddled.

Radar Jamming

Germany got these first exposure to U. S. radar jamming in October, 1943. In a case and as often, Air Force leaders equipped with radio jamming (code named "Casper") suffered only half the losses of radio-equipped aircraft against German radar-controlled anti-aircraft batteries. At jamming equipment and techniques improved, radio losses dropped further.

Combined use of both radio and jamming radio came into play for the Germans. To enable their radar



SWEEP jamming, a more sophisticated technique, concentrates jamming power in narrow band but can be used against jamming operating at different frequencies.



CLIFTON HEIGHTS, PA.

DECEMBER 1957

Vol. 1, No. 1

CLIFTON PRECISION ANNOUNCES NEW WESTERN DIVISION



New Clifton Precision plant at Colorado Springs, Colorado

ONLY OUTSTANDING PERFORMANCE MAKES GROWTH LIKE THIS POSSIBLE

Today shipments of CPCC rotary components are running 4 times the rate of two and a half years ago (see chart).

The new facility will permit a further 100% increase in rate of shipments.

Only outstanding performance makes growth like this possible. CPCC synchros have provided highest accuracy and reliability in the least bulk and weight.



Colorado Springs Area Named Production Capacity Doubled

Clifton Heights, Pa., November 4, 1957—Clifton Precision Products Co., Inc. today announced completion of arrangements for the purchase of a 37,000 sq. ft. plant at Colorado Springs, Colorado. The plant will approximately double the Company's capacity to produce synchros and electro-mechanical components for aircraft and missile instrumentation, guidance and control.

The new plant, which is situated on 13 acres of land at the foot of the Rocky Mountains, is presently being equipped and will be in production shortly.

Clifton Precision is a leading independent manufacturer of synchros, servo motors and all types of rotary components for airborne electronic equipment. The Company has specialized in sub miniaturized, high accuracy units.

to distinguish among beacons from slow drifting clouds, the Germans developed and added moving target and motion (MTI) circuits. But this made the radar more vulnerable to Allied jamming.

In the Pacific Theater, B-29s were afflicted with jamming equipment following electronic countermeasures in the course of Japanese ground raids on daylight raids when B-29s flew clear formation, one jammer in a single B-29 could protect the entire group against a single ground radar. If there were several Japanese radars, each operating at different frequencies, jamming in a single B-29 was not one against each enemy radar.

But for the lone formation and in night missions, a single jammer could not protect the group. A few B-29s were therefore outfitted at electronic counter measures units, equipped with as many as 16 jammers, plus receivers and operators.

Nicknamed "porcupines" because of their many spindly electronic counter measures antennas, these aircraft flew high over the target area along a course parallel to the incoming B-29 formation and jammed ground radar until the raid was completed.

Jamming Techniques

World War II jamming employed techniques adapted from radio jamming. Most radars used jamming radar signals a while (usually) more noticeable than the transmitted carrier. On early World War II Air Corps radar positions, which showed a target blob along a horizontal line calibrated in range to target, the whole scene appeared a target blob in tall grass with a golf ball.

Because radar receivers are designed to operate from extremely low level signals reflected from the target, a modest power jammer in the target is sufficient to swamp the radar echo. For example, original Carpet jammer had output of only 5 w., later raised to about 15 w. The subsequent AN/APQ 9 had an output of only 25 w.

As electronic countermeasures techniques developed since the war, such as the use of subcarriers and the use of the delay reject rather than the use of the present of random noise. This has forced electronic countermeasures to develop more sophisticated techniques, most of them related to the present-day characteristics of radar.

A radar receiver can be confused by a radar and its operator is to design electronic countermeasures to confuse the radar by jamming. Radar has two basic techniques for determining target bearing and range. The direction is found by the radar antenna's pointing while the echo is received exhibits target bearing. Target time required for a radar



ASSOCIATION of Old Crows is national association of persons who use or use others in electronic countermeasures. Name is derived from "Crows" only name used in World War II countermeasures. For more information write Old Crow Headquarters, CCH Laboratories, 151 Lusk St., Reno, Nev. 89501.

able to travel from the antenna to the target and back determines target distance.

False Targets

One of the most obvious ways to fool a radar is to create a number of false targets, each at a slightly different range but at roughly the same bearing as the actual target. This can be accomplished by equipping the target with a small electronic countermeasures transmitter which sends out a series of pulses at regular intervals such that the radar interprets them as one target.

If the electronic countermeasures pulses have the same length (time delay), repetition rate and carrier frequency as the transmitted carrier, this cannot be distinguished from echoes returned by actual targets (unless the radar employs suitable constant-frequency countermeasures techniques). The frequency of the transmitted carrier is a series of steps over one of which is the actual target. Under certain conditions, the radar may display only the false target blips and the actual target position may just even appear on the scope.

Range Pull-Off

For subminiaturized synchros and other guided missiles, accurate information on target range and rate of change is needed to compute integrated future position of the target at which the interception or attack should be aimed. If false range information is provided by the radar, as the result of electronic countermeasures action, the computer produces erroneous guidance instructions which will misguide the interceptor or missile.

When an intercepting/evade radar has locked onto its target, several tracking circuits within the radar are effectively clamped onto the echo returned from the target. This allows any change in target bearing or range. One sophisticated countermeasures approach intended to provide erroneous

range data is called "range pull-off." Here the target electronic countermeasures transmitter sends forth a single pulse at a predetermined rate, each pulse coming from the radar so that the jammer effectively strengthens the weak echo returned from the target. Then the target's electronic countermeasures transmitter slowly begins to shift the timing of its own pulse train increment corresponding to a change in target range. The radar tracking circuits eventually follow the signal received from the electronic countermeasures transmitter, ignoring the far weaker signal (echo) received from the target itself.

Operation of false target bearing is lessened when countermeasures protection for a target that producing spurious target range signals. However, the former is a far more difficult task for electronic countermeasures.

If countermeasures reveal that a resistance radar in the jammed has a significant side lobe because of joint or beam design, these small low-power beams on either side of the main beam can be used to produce false target bearing information. The target jammers maintain silent when it is threatened by the main beam, but send out spurious pulses when threatened by the side lobes. This causes spurious targets on the radar scope whose bearing will drift by a few degrees from true target bearing.

Decey Missiles

Most attempts to produce growth including target bearing information on microwave radar scopes are to use radar guided interceptors and missiles to intercept the target. Such a missile carried under the wings of a bomber, for example, might be equipped with simple limited radar reflectors which enhance the radar strength to the target from the front appear to be a bomber. On the ground, with a small electronic countermeasures receiver transmitter.

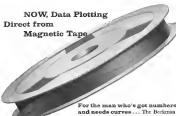
When a bomber's electronic countermeasures transmitter is jammed, it is being threatened by radar energy, so countermeasures receivers are first used to analyze the radar's characteristics, i.e., frequency, pulse length, repetition rate, etc. The electronic countermeasures transmitter in the intercepting missile then acts, in remote control, to mislead the radar to be jammed, and is fired on.

Because the missile's electronic countermeasures transmitter can produce a strong signal with the bomber itself, the radar will lock onto the decoy.

When the decoy missile is launched, the radar will follow it instead of the bomber.

Air Force estimates that at least two

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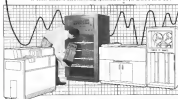
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The typical data plotting installation consists of the Beckman
Tape-to-Curve Converter, IBM System/360 Punch, IBM
Magnetic Tape Unit, and an Electronic Analyzer/Plotter.

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electronic countermeasures (ECM), was
first under development. One effect
the Quail is being developed by Mc
Donnell Aircraft Co. The other, called
the Goose, is being produced by Curt
Wright.

Another type ECM, made for de-
placement against infrared-guided mis-
siles like the Sidewinder, could be
equipped with high infrared discs in-
stead to lure the missile away from
the aircraft's jet engine tail pipes. In-
stalling of infrared sensors in the direct
sight of the word, is impossible be-
cause they do not radiate electronic
energy but merely sense radiation
emitted by the target.

Combined Techniques

In operational use, countermeasures
passive and active electronic counter-
measures equipments are usually em-
ployed in combination. For example,
infrared sensors used to monitor in-
coming radar/radio facilities were first
available to England, passing in order
to determine whether the enemy has
most radar/radio facilities which it is
looking in range.

Employment of both active and pas-
sive countermeasures often makes it
more difficult to develop countermea-
sures. Countermeasures techniques—as
demonstrated by Germany's experience
in World War II.

Number and variety of electronic
countermeasures equipment carried
aboard modern battleships has had such a
Topsy-turvy growth in recent years that
the writer has been forced to adopt a
warrior's systems approach. For example,
Sylvania is developing a complete electro-
nic countermeasures pod which can be
carried by the B-51 in lieu of a bomb
load to provide an electronic counter-
measures umbrella for long-ranging
B-51. Spain Rand recently scored an
\$88 million contract to develop a
similar pod for the B-51.

Smaller integrated electronic counter-
measures pods are being developed for
use by fighter aircraft.

Counter-Countermeasures

Clawing effort is electronic coun-
termeasures, resulting from the fact in
increasing reliance dependence upon de-
terministic radiation for detection,
weapons guidance and communications,
has in turn generated a growing effort
in electronic counter-countermeasures.
Rumel Air Development Center is
working hard a major modern improvement
on the subject.

Electronic counter-countermeasures
like electronic countermeasures, is a po-
tential battle of wits between man-
made wits and those who use
the radio/radar natural and counter-
measures equipment.

A few examples will illustrate the
nature of electronic counter counter-



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maneuver. Most of the power and other electronic countermeasures devices described must be trained to the operating frequency of the radar before they can be effective. The obvious way to counter such frequency sensitive devices is to design radar/radar systems so they can change their operating frequency quickly.

DEW Line radar, for example, is incapable of this process.

To meet this challenge, electronic countermeasures designers try to develop equipment which is effective over a broad frequency range, or which can switch frequency rapidly. However, any time lag between a change of radar frequency, and the resultant shift in electronic countermeasures frequency, can alert the radar operator to the jammer's presence.

Against jammer attack with its own radar, other electronic countermeasures techniques can be employed. For example, the radar may switch to a different pulse length in repetitive use, or employ a continuous changing pulse repetition rate. There are other, more sophisticated techniques which can be used to give a radar jammer its own special anti-flickers, making it more difficult for electronic countermeasures to ignore the radar 100% of the time.

Quick Reactions

Successful electronic countermeasures and electronic counter-countermeasures depend heavily upon good reconnaissance of enemy electronic facilities and quick action capability in developing equipment to deny the enemy effective use of his facilities.

Quick action capability is particularly important in time of war. During World War II the British radar countermeasures able to develop new electronic countermeasures equipment and put it into operational use within two weeks after a war, German radar in radar put in its appearance.

Boeing Air Development Center, which is responsible for sponsoring the development of all Air Force ground based electronic countermeasures, main-

tains an intense capability for speed development of electronic countermeasures equipment and sponsors a similar capability with at least one other manufacturer.

Boeing Air Development Center also sponsors two electronic countermeasures test sites near Rome for evaluating effectiveness of ground-based and airborne electronic countermeasures. Bases are equipped with almost every type of radar and countermeasures equipment in the past and present military inventory to test their electronic countermeasures vulnerability. Additionally, the Yellowknife, N.Y., site operates a small electronic countermeasures range under Rome control, now under modified to operate at frequencies known to be used by the Russians.

Never Ending Race

Designing electronic countermeasures and electronic counter-countermeasures is a never ending race. When electronic countermeasures designers come up with new techniques to jam or confuse existing U.S. radar, radar designers are forced to develop techniques for countering the new techniques.

In one sense the airborne countermeasures designer has an easier task than those designing ground based electronic countermeasures because passive reconnaissance provides the former with considerable information about the enemy ground based radar radar he must counter. The ground based electronic countermeasures designer must work with far less information on the type of enemy radar/radar that may be used against him.

On the other hand, designers of airborne countermeasures equipment are relieved by the familiar limitations on size, weight, power consumption and complexity. The ground-based radar/radar designer can consider considerable wiring capabilities in his anti-jamming circuits and can use the brute strength approach of tremendous power.

Neither designer has a host of races. The development of sophisticated countermeasures equipment requires a detailed understanding of the operation of the equipment to be jammed in order to make the most effective use of a technique inherent in the equipment design.

A brief four years ago, airborne electronic countermeasures was available for electronic countermeasures development and these were comparatively few components in the inventory. Today electronic countermeasures is comparatively lag behind with neither premanufactured nor stock at least 5400 million annually and with at least 16 companies active in the field. The general emphasis on electronics, and their growth in electronics, also indicates suggests there will be growing emphasis on countermeasures.

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Orders should be addressed to: Aviation Week, Reprint Section, 180 West 42nd St., New York 36, N. Y.



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English Electric Co. Aims for Reliability

London—One and a half million dollars in research and development funds, claimed to be the largest in Europe, is concentrated on aircraft electrical equipment has been opened by the English Electric Co., Ltd.

The company is to concentrate on a program. One of the main objects of the development program is to improve the performance and reliability of electrical equipment in high speed aircraft. The main problems are those arising in high altitudes from low humidity, high ambient temperatures and the reduced dielectric properties of air at low pressures.

One of the most recent problems is brush arcing. The company is concentrating on a broken alternative electrical rotating machines and has made good progress. Development of a "static" control gear is another major item in the company's effort to eliminate the most serious source of unreliability. But a great portion of the company's effort is directed at improvement of details and the application of a whole new family of improve and other non-metallic in switches, lubrication and sealing materials. Silencers are used in the interior of everything," and Chief Engineer E. Russell to Avionics. "We're in fact, they have not lived up to expectations."

Laminates developed for tape and sheeting requirements up to 250°C for the use of other outside areas as well as being with glass cloth. Therefore a used cut-increase at the lower temperatures range.

Among the latest machine materials are the epoxy resin filled with quartz filler.

Recent patent component developments include a.c. motor of only 1-in. diameter incorporating diamond, etched laminations, integral windings for 300 megawatt generation and transmission.

English Electric is the only company offering a complete turnkey contracting system for manufacturing aircraft in which alternatives are connected to install, and are used and governed to share the load automatically. The company studies the Swindon's Unidrive channel conduct speed drive under license for this purpose. The first aircraft to be fitted with the system is Britain's all the Vickers. The system is being used in the Vickers in its integral equipment amounts to around 400 lb. and a reduction in the cooling drag pounds imposed on the machine by the equipment means another 700 lb. for the payload.

The equipment is highly conventional and includes batteries of dynamic

action able to modulate complete aircraft electrical system under load, high altitude electrical insulating conditions at 90,000 ft and capable of automatic during complete electrical systems on do load, surge and endurance when test being equipped, a C-130 and an explosion chamber and seismic test rigs.

Expansions, Changes In Avionics Industry

Electronic Specialty Co., Los Angeles, has purchased the Radio Division of Electronics Inc., which will be added to the company's existing Radio Division. New acquisitions produce telecommunications in other and being matches, expanding Electronic Specialty's own line of 30-100 products.

Other recently announced changes, expansion in the avionics industry include:

• **Ultrasonics, Inc., Albuquerque, N. M.**, has purchased products and physical assets of Quantum Electronics, Inc., also of Albuquerque. New acquisitions include Ultrasonics a division of Ultrasonics manufacturers power supplies, instrument modules. T. E. Lenneman, president and treasurer of Quantum Electronics, will continue to head its operations.

• **General Mills** has formed a Nuclear Equipment Division, at part of company's Machine Division, to develop and produce remote control handling equipment for use in nuclear laboratories and reactors.

• **Jefferson Electric Co., Chicago**, maker of transformers, will purchase Electronic Products Corp., Santa Barbara, Calif., which produces custom electronic cables and remote assemblies, providing stockholders approval. Purchase price is approximately \$570,000. Rather management staff of Electronic Products Corp. will be retained.



• **Quadrangle Diversity Southern Long** may make additional long-term acquisitions, which General Electric is building for Air Force use in the Arctic will supply "quadrangle diversity" to electronic tubing. Two large antennas, 150 ft high, in 120 ft high, will be employed at each horizon and rack will be fed both horizontally and vertically polarized signals simultaneously. New system, expected to have a single-loop range of 700 miles, was developed by Hughes Laboratories. Working mock-up of the system, suitable for complex operation.

above, will undergo test work next year between Boston and Washington, D. C.

• **New USAF Communications Center**—Part of the new high-speed telephone system, capable of handling three times as many messages with less than half the personnel formerly required, has gone into service at Andrews AFB near Washington, D. C. System was designed, installed and based on Air Force by Western Union. Other four centers located at Wright-Patterson AFB at Dayton, Robins AFB at Macon, Ga., McClellan AFB at Sacramento, Calif. and Carswell AFB at Ft. Worth are slated to be completed by end of next year. The new high-speed system will face half more than 200 USAF air-to-air communication points throughout the nation.

• **For the Record**—Automatic 35 mm camera that photograph traffic control aids using with own own group of the internal, brushless photo-gating a clock to show exact time of each shot, are being installed, especially in Civil Aeronautics Administration towers in New York, Chicago, Washington and Norfolk, for assistance in controlling air traffic control color vision system. The camera are produced by General Enterprises, North Hollywood, Calif.

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CAA Contracts

Washington—Following is a list of contracts as released by the Civil Aeronautics Administration.

Three manufacturing contracts for the production of 100 aircraft for the Civil Aeronautics Administration (CAA) are being awarded to the following companies:

Boeing Aircraft Co., Boeing, Wash., \$1,000,000 for 100 aircraft.
Cessna Aircraft Co., Cessna, Okla., \$1,000,000 for 100 aircraft.

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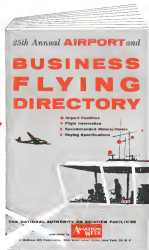
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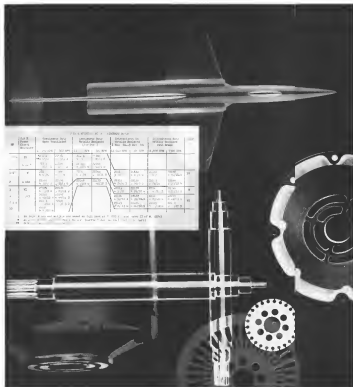
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AIRCRAFT SYSTEMS AND EQUIPMENT

LETTERS

Editorial Proponents

Congratulations to your forthright thought-provoking and touchy editorial "Let's Ignore Without Leadership" appearing in the Oct. 25 issue of *Vocations* Week. I sincerely hope it commands the attention of all such deserts.

I could not agree more to the need for further implementation of lessons learned from our law intelligence efforts.

B. S. Rana et al.

Vice President, Engineering
Tetra Tech Aerials, Inc.
Knox, Tenn., Mo.

Just a word of complement in view will spoken editorial of \$10. 24 citing the discrepancy between knowledge of what potential returns are doing and judgment in response to meet their needs.

In his monograph a further problem worth pointing up, Vinj Alexander de Soreville called attention to this in a recent speech before the New York Chapter of the Armed Forces Communications and Electronic Association. He said: "We are heading in clear direction, trying to be strong everywhere, something we scientists and industrial giant over the entire spectrum of weapons from bayonets to space jets."

In this article and vignettes, we present various home loans of the old group as almost enough of the new. It is fortunate to come across, that sense, makers of delirious art, being put to true young men as such things to the removal of some and the Revolutionary War practice of holding them back, docks of savings when those dollars are needed for the most advanced type of economy.

Too much of what we are being told is to be produced on the word for looping round shows of effort at nice diction.

JOHN MARCHALLA
Executive Director
Strategic Initiatives, Asia
Los Angeles, Calif.

I read your recent editorial "Intelligence Without Leadership" (Oct. 25) with interest after months reading *Things in the Sky*. In *Peace Christmas* (Foreign Books), Mr. Christmas describes the tragic events which occurred at Pearl Harbor and Estonia and the historic blunders of leadership and organization.

It is almost impossible to understand what kind of leadership would permit a group to make the same mistakes with disastrous consequences. It seems, however, that the very thing is happening according to your editorial.

I think it would be a source of some importance and interest for many who are in responsible positions in and your editorial staff raising the question of the kind of defence of Britain with absolute F-105 and F-106s fighting against the overwhelming support of the Japanese. Now it is conceivable that air men could again get the responsibility for the disaster and the destruction which was the cause of Pearl Harbor.

Acting: *Work* includes the names of its readers on the money spread in the magazine's editorial columns. Address: Letters to the Editor, American Work, 330 W. 42 St., New York 36, N. Y. To keep letters on file 300 words and give a gratis reply. Send: We will not print anonymous letters, but names of critics will be withheld on request.

As political and military leadership in these three apparently left-winged to be desired a run-in he hoped that the leader of the Western World will take hand of their production, market, and the an issue made. (p. 17, 18) (Thompson)

It is sincerely hoped the message received by the employees is clear and its resolution accepted. Keep up the good work.

Having been active in aviation for over 25 years and having watched the growth of this industry in the U.S. under varying leadership and in many areas the industry was used as a political football if it indeed is a pleasure to find your opinions on the economy to be of some use, either.

the system, or to the different ways in which the system has been used. This means that although there is a need for hard data, S&B is the domain of integrative and creative mental knowledge, of the mindsets as reflected in our various limited and accurate appraisals of the conditions and the risks themselves that can have consequences for a defined system or system process, or for a system or system process as a whole. Whether all risk managers are in agreement or not it is obvious that they need respect for their own understanding and ability to call a spade a spade, and discuss after a sound selection of the way complex problems that require a coordinated team. My congratulations to you and to your colleagues, that you have taken the time to understand and use the way things are that can help.

Robert W. Brown
T/Sgt USMC
Decorated

Danger of Satellite

The answers embodied in the Rosenzweigles have not been clearly asked. Consider the following transformation systems:

- (1) $\alpha P^m + \beta \rightarrow \gamma P^n$
- (2) $\alpha P^m + \beta \rightarrow \gamma P^n$
- (3) $\alpha P^m + \beta \rightarrow \gamma P^n$

The utilization of the nuclei of the product isotopes is indicated by the chain reaction/energy ratio. The product isotopes ^{239}Pu , ^{240}Pu , ^{241}Pu cannot enter a chain fission reaction and only fission reactions are used to generate fission energy; the ratios fission reactions to all other reactions

Three transmutations, as he accomplished a long way, by offering the position of α α^2 in γ to carry a heavy gamma radiation with suitable characteristics. By selecting the heavy gamma rays, which are

between internal atomic planes of a crystal the beam can be coherently polarized to a degree, the energy loss (due to Compton effect) during passage through the atomic plane. Now the nuclei of heavy elements ($A > 200$) the gamma photons undergo the transformation $\gamma \rightarrow e^+ + e^-$. The capture of an electron by a nucleus and the resulting isotope, is shown in (1) (2) in (3) above.

A transmission horn as defined above, could be broadcast from a satellite, without difficulty. The signal of the opposite world, is measured as true; but the source is lifted from orbit as small increments with the flight stage returning to earth as a homeward, delay.

Note that the reactions 1, 2, and 5 are reversible. In the case of (1), the copolymers by hydrolysis is transferred back to glutamates in about two weeks. However, in the case of (2) and (5), the trans-esterification

A transvestite here would be white as
leaves in life, but this fact would offer
little consolation to a nation stripped of it.

This then is the theme of the article, the country's ability to bombard the United States with information and paralyze it as it desired.

—**Armen Nisenzon**, *Isis*
New York, New York

Moon Satellites

It has been with a great deal of interest that I have followed the article and editorial comment in my copy of *AMERICAN WARRIOR*, but there is one item in particular that I would like to bring to your attention for possible comment.

Robert W. Brown
T/Sgt USMC
Decorated

range of the photograph seems to be floating in space. In fact several of the small objects seem to be disconnected from the surface of the moon.

I know better than most, from years of working on this same subject in places as far-flung as the Arctic, that the moon just isn't doing what the idea you are believing the world is.

Cross. H. Garcia
 Capt. United Air Lines
 San Carlos, Calif.



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